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NATIONAL DAM SAFETY PROGRAM. ST. JAMES LAKE DAM (INVENTORY NUMB--ETC(U)
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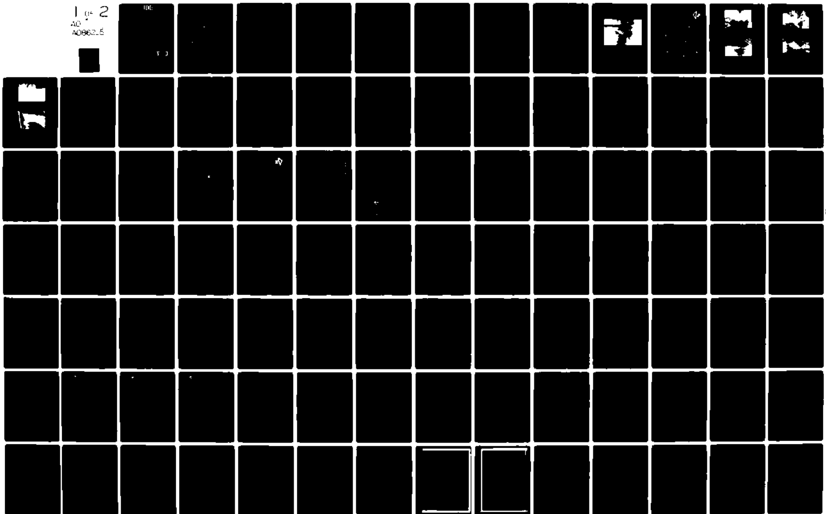

ST. LAWRENCE RIVER BASIN

ST. JAMES LAKE DAM

JEFFERSON COUNTY
NEW YORK

INVENTORY No NY 779

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

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CONTRACT NO. DACW-51-79-C0001

NEW YORK DISTRICT CORPS OF ENGINEERS

JULY 1979

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REPORT DOCUMENTATION PAGE

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Dam Safety
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St. James Lake Dam
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20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This report provides information and analysis on the physical condition of the dam as of the report date. Information and analysis are based on visual inspection of the dam by the performing organization.

St. James Lake Dam, a small, low hazard dam, is an earthen dam constructed in approximately 1923. It is located just north of the Ft. Drum cantonment area. No plans exist for the dam, however, field surveys were taken as part of this inspection. A significant feature of the dam is that it has no emergency spillway outflow occurs. Only through a service spillway consisting of twin 42 inch pipes. The drainage area is 5.14 square miles.

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The spillway capacity of 400 cfs is only 3 percent of the Probable Maximum Flood (PMF) which was computed to be 13,670 cfs. The 1/2 PMF is 7,046 cfs. Therefore, the dam cannot pass the 1/2 PMF without being overtopped. The downstream hazard is a lightly traveled road that travels northerly from the cantonment area.

1. The discharge capacity of the spillway is inadequate for all flows in excess of 3 percent of the PMF (spillway capacity = 400 cfs). The spillway is not considered seriously inadequate based on the Corps of Engineers' screening criteria since the hydrologic/hydraulic analysis indicates that failure of the dam would not pose a high hazard to loss of life from large flows downstream from the dam. However, consideration should be given to provide an emergency spillway adequate to pass 1/2 of the PMF without damage to the structure. This may be accomplished by the construction of an emergency spillway on the undisturbed bank of the impoundment.

2. The deteriorated apron of the existing service spillway should be repaired immediately.

3. Investigations should be completed within one year to determine the source of seepage noted near the wing wall of the existing spillway.

4. The structural stability of the dam should be evaluated within one year. This evaluation should be based on the data collected in a soils investigation program on the embankment section of the dam.

5. An adequate warning system should be developed immediately to be used in the event of the potential failure or flooding.

6. Within one year, the trees and brush should be removed from both the upstream and downstream face of the embankment section. The upstream face should be protected from erosion by wave action by the placement of riprap at the waterline of the impoundment.

7. Within two years, some means should be provided for draining of the impoundment for inspection and/or maintenance procedures.

PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D.C. 20314. The purpose of a Phase I Investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation, and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I Investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. In cases where the reservoir was lowered or drained prior to inspection, such action, while improving the stability and safety of the dam, removes the normal load on the structure and may obscure certain conditions which might otherwise be detectable if inspected under the normal operating environment of the structure.

It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through frequent inspections can unsafe conditions be detected and only through continued care and maintenance can these conditions be prevented or corrected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the Spillway Test flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. Because of the magnitude and rarity of such a storm event, a finding that a spillway will not pass the test flood should not be interpreted as necessarily posing a highly inadequate condition. The test flood provides a measure of relative spillway capacity and serves as an aide in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.

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PHASE I REPORT
NATIONAL DAM SAFETY PROGRAM

Name of Dam St. James Lake Dam NY779

State Located New York
County Located St. Lawrence
Stream Pleasant Creek
Date of Inspection May 2, 1979

ASSESSMENT OF GENERAL CONDITIONS

St. James Lake Dam, a small, low hazard dam, is an earthen dam constructed in approximately 1923. It is located just north of the Ft. Drum cantonment area. No plans exist for the dam, however, field surveys were taken as part of this inspection. A significant feature of the dam is that it has no emergency spillway outflow occurs. Only through a service spillway consisting of twin 42 inch pipes. The drainage area is 5.14 square miles.

The spillway capacity of 400 cfs is only 3 percent of the Probable Maximum Flood (PMF) which was computed to be 13,670 cfs. The 1/2 PMF is 7,046 cfs. Therefore, the dam cannot pass the 1/2 PMF without being overtopped. The downstream hazard is a lightly traveled road that travels northerly from the cantonment area.

1. The discharge capacity of the spillway is inadequate for all flows in excess of 3 percent of the PMF (spillway capacity = 400 cfs). The spillway is not considered seriously inadequate based on the Corps of Engineers' screening criteria since the hydrologic/hydraulic analysis indicates that failure of the dam would not pose a high hazard to loss of life from large flows downstream from the dam. However, consideration should be given to provide an emergency spillway adequate to pass 1/2 of the PMF without damage to the structure. This may be accomplished by the construction of an emergency spillway on the undisturbed bank of the impoundment.

2. The deteriorated apron of the existing service spillway should be repaired immediately.

3. Investigations should be completed within one year to determine the source of seepage noted near the wing wall of the existing spillway.

4. The structural stability of the dam should be evaluated within one year. This evaluation should be based on the data collected in a soils investigation program on the embankment section of the dam.

5. An adequate warning system should be developed immediately to be used in the event of the potential failure or flooding.

6. Within one year, the trees and brush should be removed from both the upstream and downstream face of the embankment section. The upstream face should be protected from erosion by wave action by the placement of riprap at the waterline of the impoundment.

7. Within two years, some means should be provided for draining of the impoundment for inspection and/or maintenance procedures.

Dale Engineering Company.

John B. Stetson

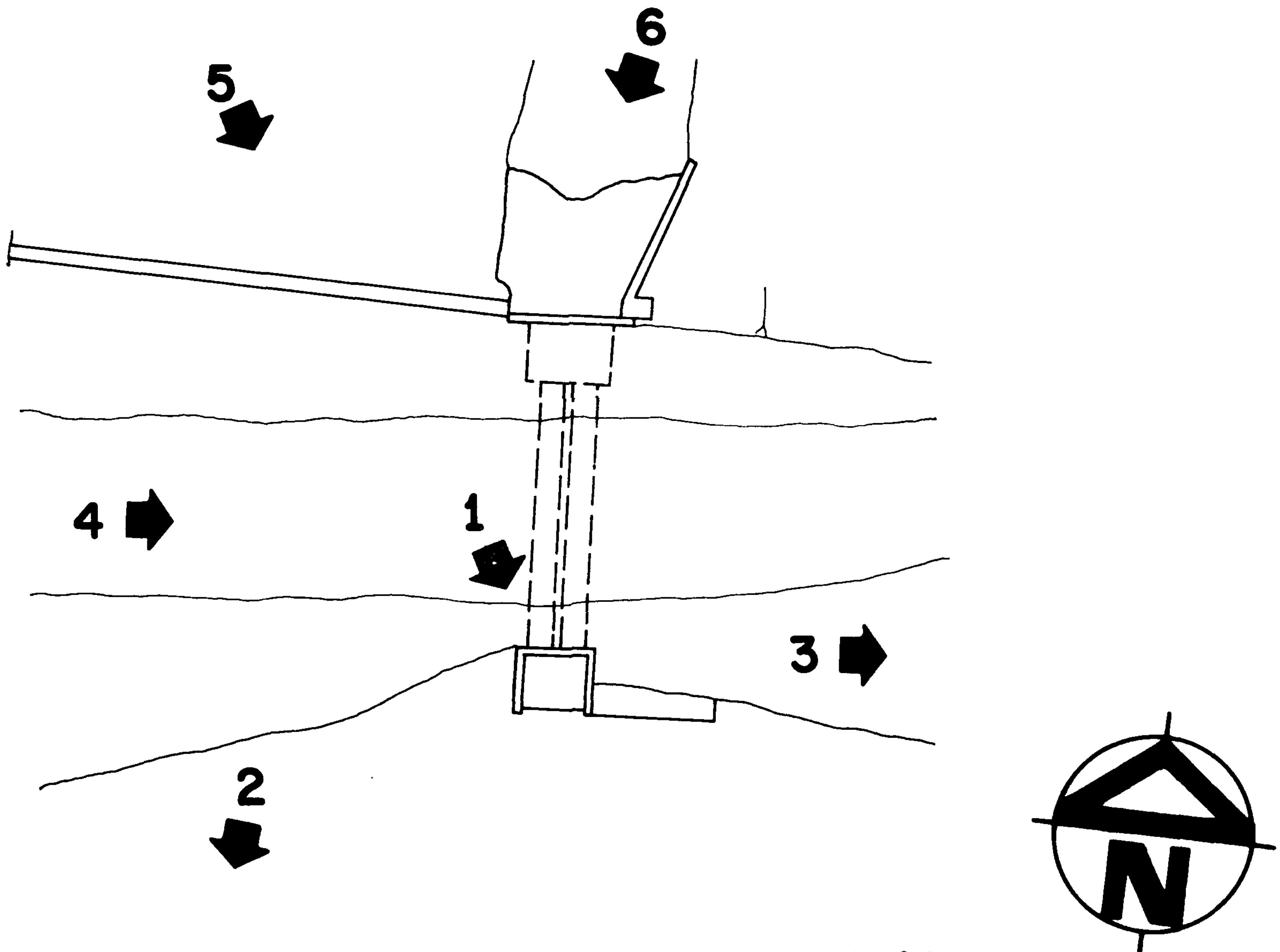
John B. Stetson, President

Clark H. Benn

Approved By:
Date: 14 Feb 80

Col. Clark H. Benn
New York District Engineer

Overview of front of dam showing service spillway. Dam does not have an emergency spillway or weir type spillway.



PHOTOGRAPH KEY PLAN

1. Close-up of inlet structure of service spillway. Spillway can be seen on right wall.

2. View of upstream reservoir.

3. Large tree growth on upstream face of dam.

4. View of earthen road across top of dam. Ratio of width of dam to height of dam quite large.

5. Downstream face of dam contains significant large tree growth.

6. Downstream view of service spillway pipes. Discharge channel lined with concrete with large cavity in concrete at toe of embankment and natural channel.

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM
NAME OF DAM - ST. JAMES LAKE ID# - NY799

SECTION 1 - PROJECT INFORMATION

1.1 GENERAL

a. Authority

Authority for this report is provided by the National Dam Inspection Act, Public Law 92-367 of 1972. It has been prepared in accordance with a contract for professional services between Dale Engineering Company and Department of the Army, New York District, Corps of Engineers.

b. Purpose of Inspection

The purpose of this inspection is to evaluate the structural and hydraulic condition of the St. James Lake Dam and appurtenant structures, owned by the United States Government, Fort Drum Military Reservation, and to determine if the dam constitutes a hazard to human life or property and to transmit findings to the New York District, Corps of Engineers.

This Phase I inspection report does not relieve an Owner or Operator of a dam of the legal duties, obligations or liabilities associated with the ownership or operation of the dam. In addition, due to the limited scope of services for these Phase I investigations, the investigators had to rely upon the data furnished to them. Therefore, this investigation is limited to visual inspection, review of data prepared by others, and simplified hydrologic, hydraulic and structural stability evaluations where appropriate. The investigators do not assume responsibility for defects or deficiencies in the dam or in the data provided.

1.2 DESCRIPTION OF PROJECT

a. Description of Dam and Appurtenances

The St. James Lake Dam is an earth fill embankment approximately 200 feet long with an irregular top width of approximately 20 feet. The height of the structure is approximately 20 feet. The dam is traversed by a dirt road that forms a part of military reservation road network.

The upstream face of the dam slopes gradually at a slope of 1 vertical to 4 horizontal into the impoundment. The downstream slope varies and in some areas the downstream slope is supported by a masonry wall.

Just to the east of the outlet channel at the toe of the downstream slope exists the remains of an old mill building. The flow from the reservoir is conducted across an 8-1/2 foot wide spillway structure which discharges through two 42 inch iron pipes to a concrete and masonry apron on the downstream slope of the dam. The concrete apron at the outlet of the 42 inch pipes was badly deteriorated near the toe of the slope. The receiving stream is overgrown with brush but there is no evidence of recent erosion in the channel.

The impoundment formed by the St. James Lake Dam is used for recreational purposes. There is no facility for draining the impoundment and no emergency spillway provided.

b. Location

St. James Lake Dam is located in the Town of LeRay, Jefferson County, New York. The facility is also located on the Fort Drum Military Reservation.

c. Size Classification

The maximum height of the dam is approximately 20 feet, the storage volume of the dam is approximately 105 acre feet. Therefore the dam is in the Small Size Category as defined by The Recommended Guidelines for Safety Inspection of Dams.

d. Hazard Classification

The receiving stream from the impoundment flows through an undeveloped section of Fort Drum. Approximately 1500 feet downstream from the dam the receiving stream crosses one of the main roads serving the military post. This road is not heavily traveled, therefore, the dam is in the Low Hazard Category as defined by The Recommended Guidelines for Safety Inspection of Dams.

e. Ownership

The dam is owned by the United States Army.

f. Purpose of the Dam

The dam presently impounds a reservoir which is used for recreational purposes for the Fort Drum Military Reservation.

g. Design and Construction History

Documents collected from the New York State Department of Environmental Conservation indicate an application for construction of the dam was made in January 1923. There is no evidence as to when the dam

was constructed. The description of the dam in the permit application does not conform to the configuration found in the field. There is no information available as to the date of the construction of the present facility or of any of the details of construction.

h. Normal Operational Procedures

There are no formal operating procedures for the facility. The road across the dam is a part of a lightly traveled network of military roads in the area. The impoundment is used for recreational purposes and normal surveillance would be provided through the use of this facility.

1.3 PERTINENT DATA

a. Drainage Area

The drainage area of the St. James Lake Dam is 5.137 square miles.

b. Discharge at Dam Site

No discharge records are available for this site.

Computed discharges: (Through twin 42 inch pipes, no emergency spillway)

Ungated spillway, top of dam	400 cfs
PMF	13,760 cfs
1/2 PMF	7,046 cfs
Draw down, (Through Service Spillway Only)	400 cfs

c. Elevation (Assumed Datum)

Note: There is no U.S.G.S. control in the area. Elevations were measured in local datum and approximate U.S.G.S. elevations are given in parenthesis.

Top of dam	102.6	(517.0)
Maximum pool - PMF		(525.16)
1/2 PMF		(522.08)
Spillway crest	95.5	(511±)
Stream bed at centerline of dam		(494±)

d. Reservoir

Length of maximum pool (PMF)	5000 FT (1/2 PMF)
Length of normal pool	2500 FT

e. Storage

Top of dam	288±Acre Feet
PMF	438 Acre Feet
1/2 PMF	381 Acre Feet
Normal pool	179 Acre Feet

f. Reservoir Area

Spillway pool 18.37±Acre

g. Dam

Type - Earth fill
Length - Approximately 200 feet
Height - 20 feet
Freeboard between normal reservoir and top of dam - 4 feet
Top width - Irregular 20± feet
Side slopes - Upstream 1 vertical/4 horizontal
Downstream varies
Zoning - Unknown
Impervious Core - Unknown
Grout Curtain - Unknown

h. Spillway

Type - Weir - service spillway, no emergency spillway.
Length - 8.5 feet weir discharges through twin 42 inch iron pipes.
Crest Elevation - Datum - 98.26 (509.26).
Gates - Stop planks in service spillway.
U/S Channel - Natural.
D/S Channel - Natural stream channel.

i. Regulating Outlets

Regulation of water level through use of stop planks in service spillway. Three feet of stop planks in place at time of inspection.

SECTION 2 - ENGINEERING DATA

2.1 DESIGN

There is no information available regarding the design of this facility.

2.2 CONSTRUCTION

No information is available regarding the construction of this facility.

2.3 OPERATION

See Section 4.

2.4 EVALUATION

Although there is no engineering data or construction information available for this facility, the fact that the impoundment is in the Small Size classification and Low Hazard classification allows evaluation of this facility for the Phase I investigation.

SECTION 3 - VISUAL INSPECTION

3.1 FINDINGS

a. General

The St. James Lake Dam was inspected on May 2, 1979. The dam presently functions to provide a recreational facility for the Fort Drum Military Reservation.

b. Dam

The dam and spillway are shown in the Sketches prepared by Dale Engineering Company in Figure 3. The date of the construction of the dam is not known, nor are the materials of construction. The dam is apparently constructed of earth fill. The embankment is poorly maintained and large trees have grown on both the upstream and downstream slopes of the dam. Some trees had been cut on the downstream slope and the cuttings were left on the face of the dam. A masonry wall located just to the west of the downstream outlet is in deteriorated condition as is the apron on the principal spillway. Some seepage was noted just to the east of the principal spillway. Substantial flow was observed under the east wing wall of the outlet structure. No bank protection is provided on the upstream face of the dam.

c. Spillway

The control spillway was operating at a head of approximately 3 inches at the time of the inspection. Stop planks were in place in the outlet structure to an elevation of 2 feet 9 inches above the spillway level.

d. Appurtenant Structures

There are no structures appurtenant to this dam. No provisions are made for draining of the dam except for the removal of stop planks in the control spillway.

e. Reservoir Area

The reservoir area is generally forested and does not contribute significant amounts of sediment into the impoundment. There are no areas where bank instability was noted around the impoundment.

f. Downstream Channel

The area downstream from the dam is on a flat gradient. No recent erosion was noted in the receiving stream.

3.2 EVALUATION

Visual inspection reveals that there is moderate to severe deterioration in the principal spillway apron which forms a portion of the downstream slope of the embankment dam. There is also some seepage located near the wing wall which forms the downstream apron channel. Both the upstream slopes of the earth embankment and the downstream slopes are heavily overgrown with trees and brush. Large diameter willow trees are located along the waterline of the impoundment along the upstream slope. There were no signs of cracking or structural instability in either the top of the bank or the downstream slopes. A masonry wall which supports a portion of the roadway across the dam is in a deteriorated condition, however, this masonry wall does not appear to contribute to the structural competency of the facility. The dam in general is poorly maintained and there is no program of periodic inspection of the facility.

SECTION 4 - OPERATIONAL PROCEDURES

4.1 PROCEDURES

The operation of the stop planks in the control spillway was not observed by the Inspection Team. Inquiry with the facility engineer at the Fort Drum Military Reservation indicates that no program of operation is in effect at the facility.

4.2 MAINTENANCE OF THE DAM

The dam is maintained by the facilities engineer at the Fort Drum Military Reservation.

SECTION 5 - HYDRAULIC/HYDROLOGIC

5.1 DRAINAGE BASIN CHARACTERISTICS

The St. James Lake Dam is located on Pleasant Creek approximately 1 mile north of the Ft. Drum cantonment area. The drainage area at the dam is 5.14 square miles. The topography consists of mildly sloped terrain with runoff partially originating in the cantonment area.

5.2 ANALYSIS CRITERIA

The purpose of this investigation is to evaluate the dam and spillway with respect to their flood control potential and adequacy. This has been assessed through the evaluation of the Probable Maximum Flood (PMF) for the watershed and the subsequent routing of the flood through the reservoir and the dam's spillway system. The PMF event is that hypothetical flow induced by the most critical combination of precipitation, minimum infiltration loss and concentration runoff of a specific location that is considered reasonably possible for a particular drainage area. Since this dam is in the Small Dam Category and is a Low Hazard, the guidelines criteria (Ref. 1) require that the dam be capable of passing one-half the Probable Maximum Flood.

The hydrologic analysis was performed using the unit hydrograph method to develop the flood hydrograph. Due to the limited scope of this Phase I investigation, certain assumptions, based on experience were used in this analysis and in the determination of the dam's spillway capacity to pass the PMF. In the event that the dam could not pass the 1/2 Probable Maximum Flood without overtopping, an additional analysis is to be performed on potential dam failure providing the dam was classified a high hazard. This process is done with the concept, that if the dam is unable to satisfy this criteria, further refined hydrologic investigations would be required.

Since the St. James Lake Dam is a Low Hazard Classification and not a High Hazard Classification, hydrologic dam break analysis has not been provided.

The U.S. Army Corps of Engineers, Hydrologic Engineering Center's Computer Program HEC-1 DB using the Modified Pulls Method of flood routing was used to evaluate the dam, spillway capacity, and downstream hazard.

The unit hydrographs were defined by Clark Coefficients, Tc and R. The Probable Maximum Precipitation (PMP) was 18.5 inches, Hydrometeorological Report (HMR #33) for a 24 hour duration, 200 square mile basin. Base flow for the basin was assumed to be 2 cubic feet per second per square mile, while loss rates were set at 1.0 inches initial abstraction and 0.1 inches/hour continuous loss rate. The loss rate function yielded 17.37 inches of runoff from 21.02 inches

precipitation. The PMF inflow hydrograph was determined by applying the PMP to the unit hydrographs and runoff and routing to the dam sites (Figure 4). The Probable Maximum Flood at the dam was 13,760 cfs, while the 1/2 Probable Maximum Flood was 7,046 cfs. The computed values are considered on average to be on the high side but are considered to be well with the screening criteria.

5.3 SPILLWAY CAPACITY

The dam contains only a service spillway consisting of two 42 inch iron pipes. No emergency spillway exists. The invert of the pipes are 7 feet below the top of the dam.

It is estimated that the spillway could discharge 400 cfs with the pool elevation at the top of the dam.

	Discharge	Spillway Capacity	Depth of Flow Over Dam
PMF	13,760	3%	8.16 ft.
1/2 PMF	7,046	6%	5.08 ft.

5.4 RESERVOIR CAPACITY

The reservoir capacity is given below.

Top of Dam	288 Acre Feet
Crest of Spillway	179 Acre Feet

The storage capacity curve is shown in Appendix C.

5.5 FLOODS OF RECORD

There is no information on water levels at the dam site.

5.6 OVERTOPPING POTENTIAL

The HEC1-DB analysis indicates that the dam will be overtopped as follows:

OVERTOPPING IN FEET	
PMF	8.16
1/2 PMF	5.08

The downstream hazard is a lightly traveled road heading north out of the cantonment area. Should dam failure occur, this road would be overtopped to approximately the same depth of the dam overtopping.

5.7 EVALUATION

The limited spillway capacity and lack of an emergency spillway will result in overtopping of the dam for an event of less than the 1/2 Probable Maximum event. Therefore, the spillway is an inadequate spillway system on a Low Hazard Classification dam (for all flows beyond 6% of the Probable Maximum Flood).

SECTION 6 - STRUCTURAL STABILITY

6.1 EVALUATION OF STRUCTURAL STABILITY

a. Visual Observations

Visual inspection of the earthen dam indicates no evidence of a past stability failure, and no significant embankment cracking, sloughing or erosion was noted. A laid-up stone retaining wall utilized to form an upper part of the structure's downstream side (to support a widened roadway surface across the top of the dam) shows some evidence of settlement not seriously related to the embankment behavior. The section of concrete and masonry spillway extending through the dam appears structurally sound, but the masonry and concrete comprising the walls and apron of the downstream outlet area are deteriorating along with some washout. Seepage/leakage from the spillway outlet/embankment occurs at this location.

Tall trees exist at various locations on the downstream face and also the upstream face of the embankment. Brush, fallen trees and debris cover the embankment's downstream slope and downstream channel area.

A thin concrete facing applied to the stone retaining wall provided as suppport for the widened roadway passing over the dam is cracked and loosening at locations because of tree root penetration and frost and settlement affects. This concrete facing has no apparent relationship to the embankment stability, although it has probably assisted in keeping stone in place.

Almost the entire upstream face of the embankment is submerged when the reservoir is at spillway level. At the time of the field inspection, this upstream face was submerged and not visible for evaluation.

b. Geology and Seismic Stability

The St. James Lake area is located in the St. Lawrence Valley Lowland which is part of the eastern lake section of the Central Lowland Province. It is north of the Tug Hill Plateau and at the western edge of the Adirondack foothills.

The January 5, 1973 State Report indicates the dam was sited on clay and gravel and both the right and left banks are in clay. The January 31, 1923 State Engineer Report indicates the spillway to be on hardpan and gravel. The clay is a calcareous rich clay and is considered to be a glacial rock floor. This clay is subject to leaching and may be the reason for the suspected under or through-the-dam flow.

Bedrock beneath the clay in the area belongs to the Pamelia Formation, the basal unit of the Black River Group (Middle Ordovician). The Pamelia is a calcitic dolostone which has an average silica

content of about 13 percent. Sand content increases toward the base of the unit.

Cushing (1910, p. 133-134) mentions underground flow through limestone channels in the area. He also refers to roof cave in of these channels as being common. Cushing (1910, p. 143-144) also indicates that drainage of the large sand plain located to the south of St. James Lake and north of the Black River is northward into the Indian River.

Dip of bedrock in the area is 1° to 2° southwestward. The closest known fault to the dam is approximately 10 miles to the southeast. The arcuate shaped fault line trends northeast. A linear feature 3 miles north-northeast of the dam site and having an east-west trend and which might represent a fracture is shown on the 1977 Preliminary Brittle Structures Map of New York.

Between 1932 and 1963, five minor earthquakes were recorded 8 to 10 miles southwest of the dam site. None were of an intensity greater than III (modified Mercalli Scale). One earthquake of intensity VI was recorded 26 miles southeast of the dam in 1853. Though the area is located in Zone 3 of the Seismic Probability Map, it would more properly be designated Zone 2.

c. Data Review and Stability Evaluation

Records made available provide little indication about the materials of construction and actual method of placement. Though the existing structure is primarily earthen, correspondence from 1923 dealing with the then proposed construction for this dam indicate plans for a concrete spillway structure which apparently would constitute the entire dam. Presumably, the dam was widened and lengthened, and also raised a few feet in height, since the 1923 construction to reach the present dimensions.

The embankment section of the dam appears to be in good condition structurally. Repair of the concrete and masonry spillway's deteriorated downstream section, along with provisions to determine the course of and reduce on-going seepage at this general location, need be accomplished to prevent progressive deterioration and the related detrimental affect on the embankment's structural stability.

Corrective undertakings should include the cutting of trees on upstream and downstrem slopes to eliminate the hazard of embankment damage where storms cause trees to uproot. Maintenance should extend to periodic removal of debris from the spillway area to reduce the danger that this outlet, of limited area, will become stopped.

The freeboard distance between the spillway level and the road surface along the top of the embankment is from one to two feet. Vegetation along the upstream freeboard would reduce erosion caused by normal wave action.

The dam and lake site lies in a Zone 3 Designation on the Seismic Probability Map although current recommendations revise the area to a Zone 2 Designation. Recent publications on the performance of earth dams during earthquakes implies that rolled earth embankments which include plastic, cohesive soils and are located on firm foundations (presumed for this structure) retain stability when subject to moderate earthquake forces. Affects of repeated shocks are not well established, however.

SECTION 7 - ASSESSMENT/REMEDIAL MEASURES

7.1 DAM ASSESSMENT

a. Safety

This dam does not appear to present an immediate danger to life or property, however, the condition of the apron of the spillway and the seepage located at the wing wall of the spillway channel may increase with time and reduce the stability of this structure.

b. Adequacy of Information

The information available is inadequate for complete analysis of the dam. No information was available on the construction of the present facility. The only data collected regarding the design of the structure was that for a concrete dam presumably located at the present site.

c. Spillway Capacity

The existing spillway system has an outflow capacity of approximately 400 cfs. The 1/2 Probable Maximum Flood routed through the impoundment will produce a discharge of 7,046 cfs and will overtop the dam by approximately 5 feet. The capacity of the spillway is approximately 3 percent of the Probable Maximum Flood.

d. Stability

Since there is no information regarding the design or the construction of the existing facility, the determination of the stability of the structure can be assessed only on the basis of visual observation of the existing structure. There were no apparent structural defects that would affect the safety of the embankment.

7.2 RECOMMENDATIONS

a. The discharge capacity of the spillway is inadequate for all flows in excess of 3 percent of the PMF (spillway capacity = 400 cfs). The spillway is not considered seriously inadequate based on the Corps of Engineers' screening criteria since the hydrologic/hydraulic analysis indicates that failure of the dam would not pose a high hazard to loss of life from large flows downstream from the dam. However, consideration should be given to provide an emergency spillway adequate to pass 1/2 of the PMF without damage to the structure. This may be accomplished by the construction of an emergency spillway on the undisturbed bank of the impoundment.

b. The deteriorated apron of the existing service spillway should be repaired immediately.

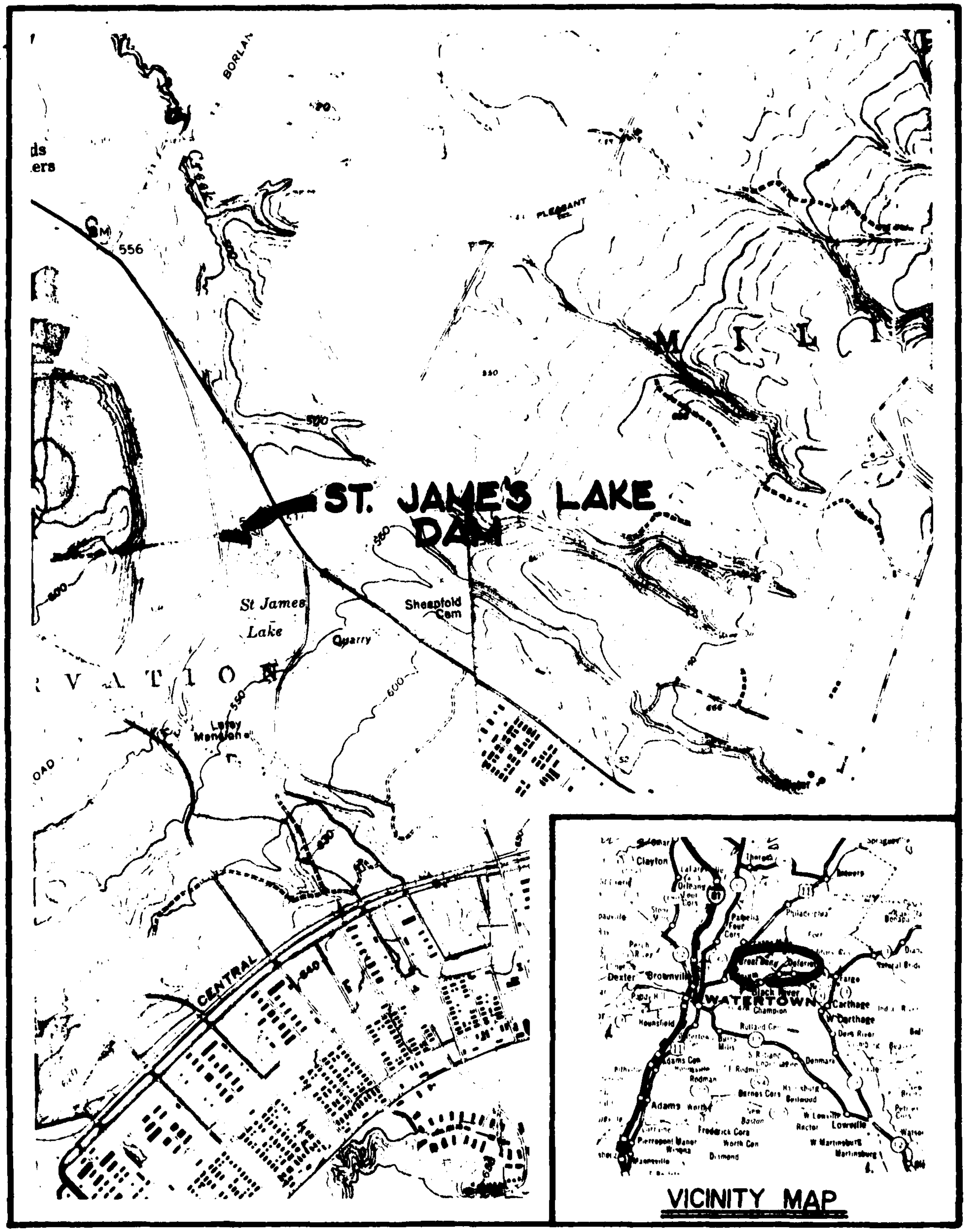
c. Investigations should be undertaken to determine the source of seepage noted near the wing wall of the existing spillway.

d. The structural stability of the dam should be evaluated. This evaluation should be based on the data collected in a soils investigation program on the embankment section of the dam.

e. An adequate warning system should be developed to be used in the event of potential failure or flooding.

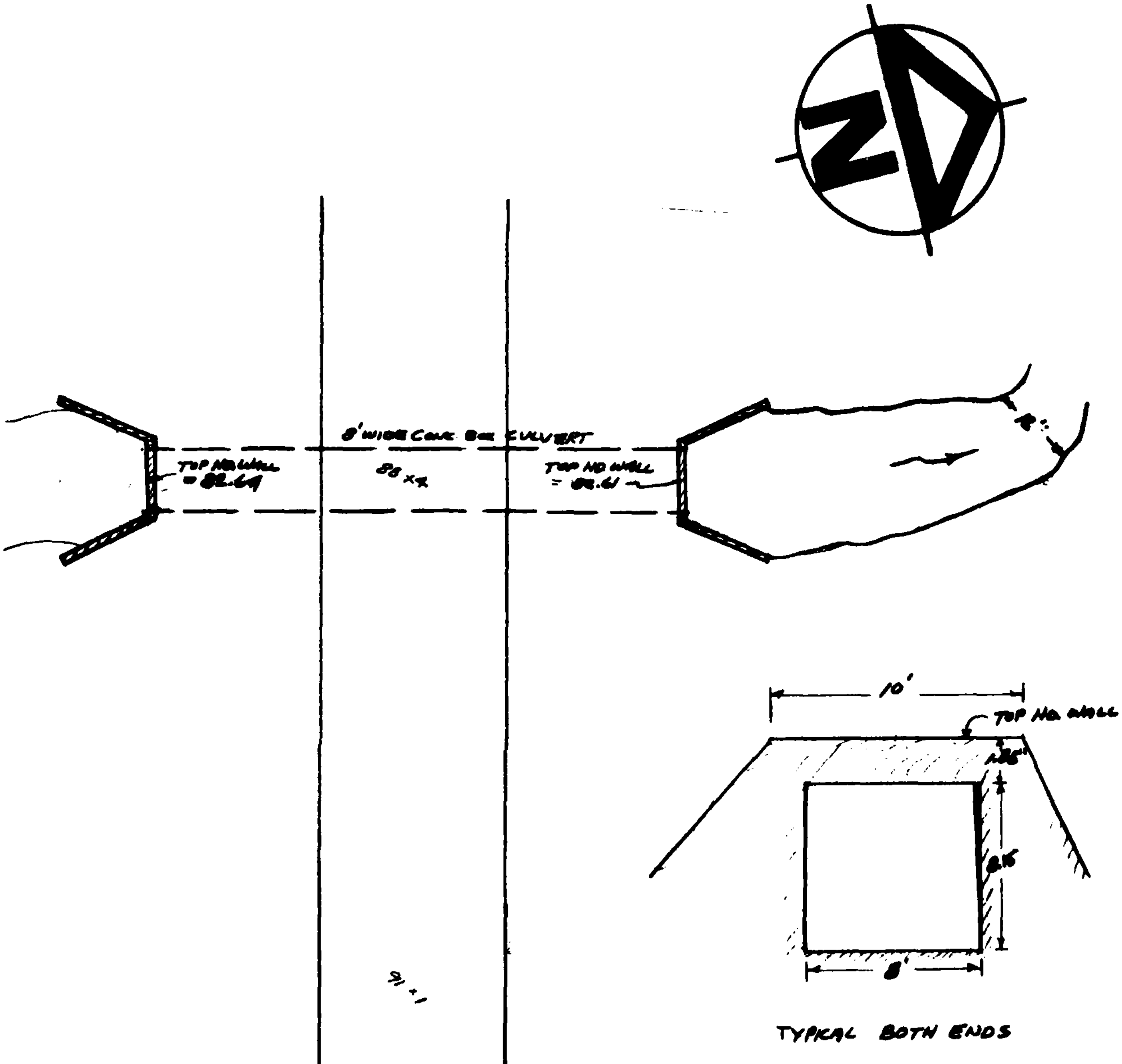
f. The trees and brush should be removed from both the upstream and downstream face of the embankment section. The upstream face should be protected from erosion by wave action by the placement of riprap at the waterline of the impoundment.

g. A means should be provided for draining of the impoundment for inspection and/or maintenance procedures.



LOCATION PLAN

FIGURE 1



DOWNSTREAM CONTROL
ST. JAME'S LAKE DAM
FORT DRUM, NEW YORK
SCALE: 1" = 20' ASSUMED

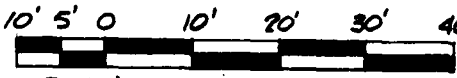


FIGURE 2

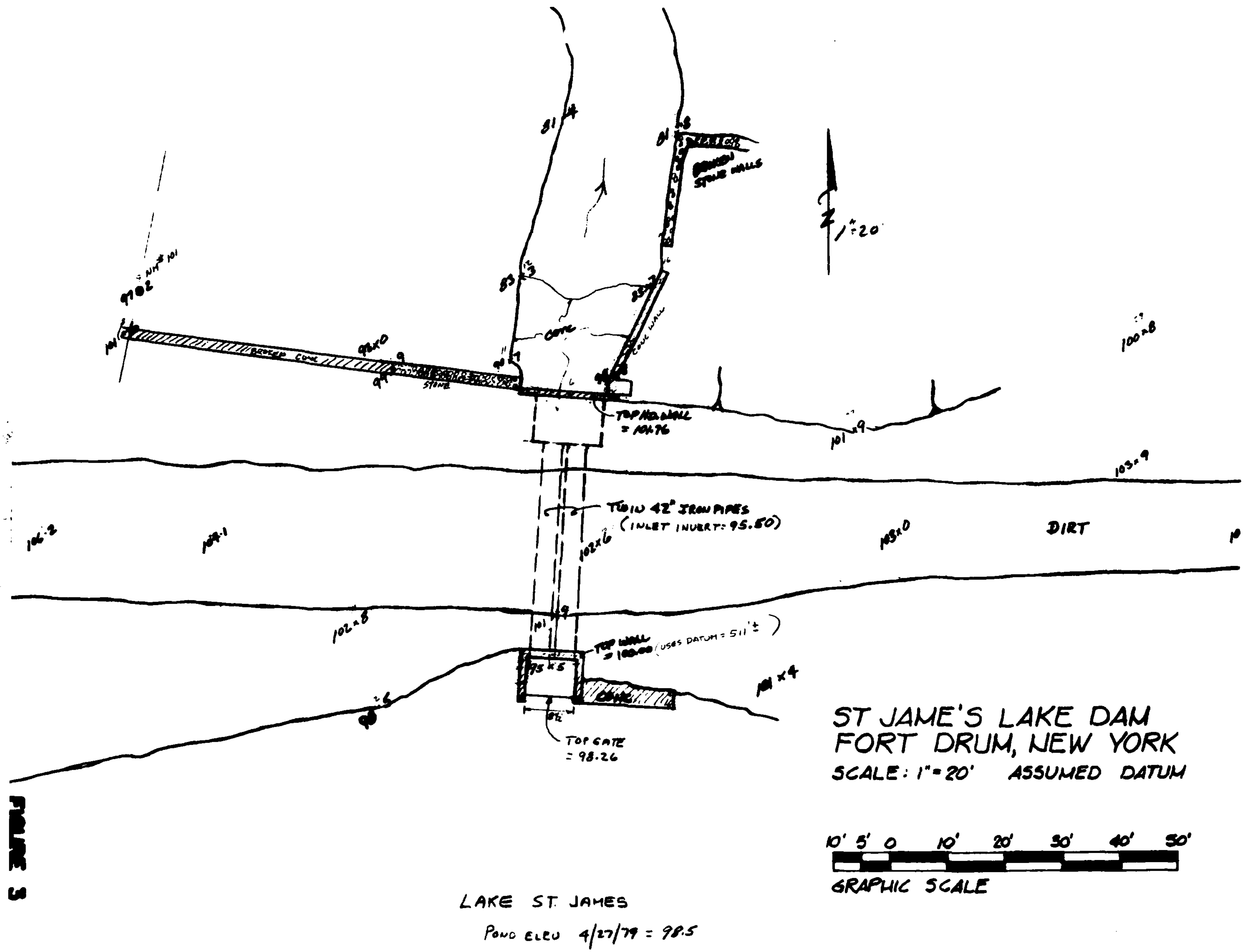
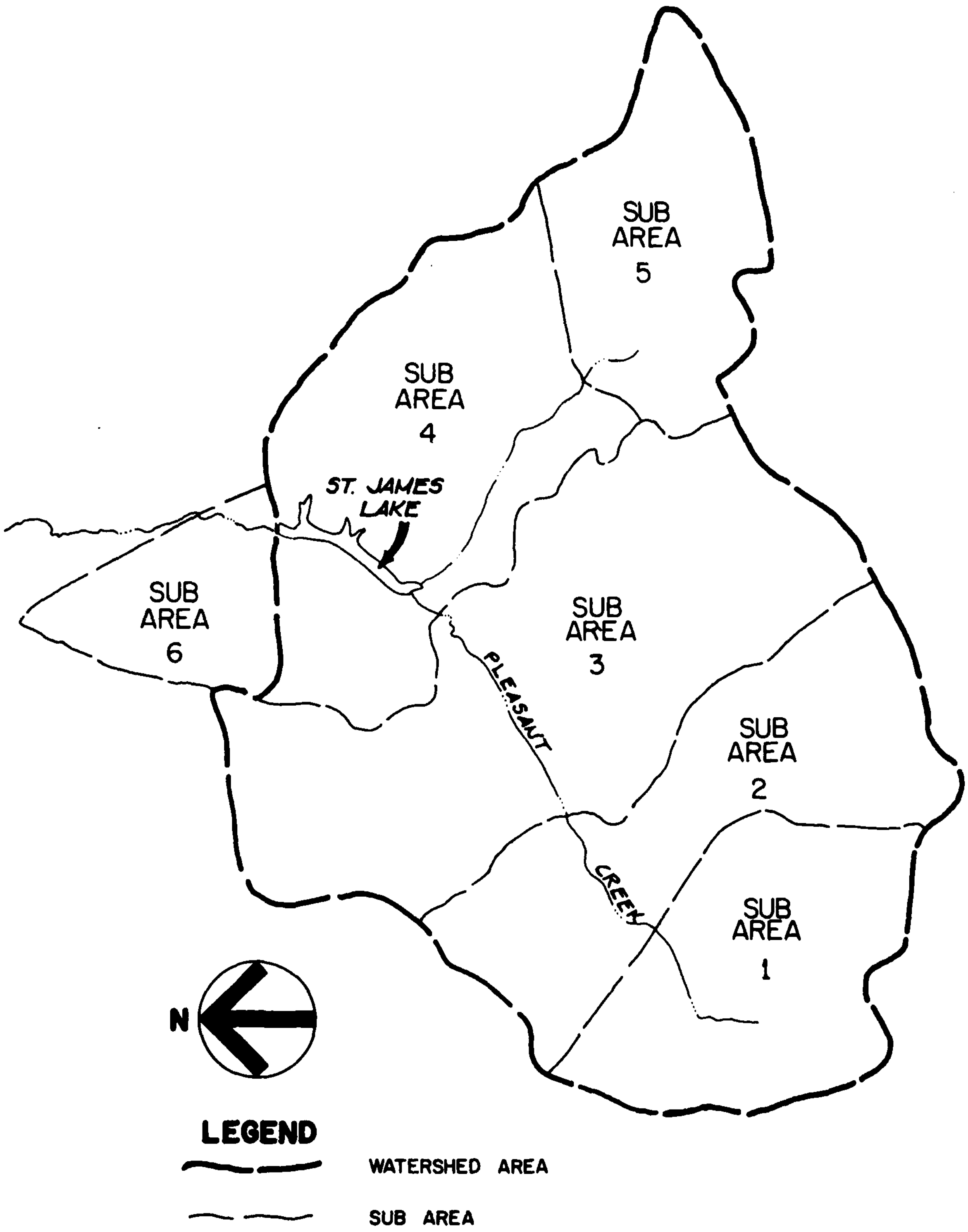

ST JAME'S LAKE DAM
FORT DRUM, NEW YORK
SCALE: 1" = 20' ASSUMED DATUM
GRAPHIC SCALE
10' 5' 0 10' 20' 30' 40' 50'
TOP HD WALL = 104.76
TWIN 42" IRON PIPES (INLET INVERT: 95.50)
TOP WALL = 100.00 (USES DATUM = 511' ±)
TOP GATE = 98.26
DIRT
BROKEN STONE WALLS
LAKE ST. JAMES
POND ELEV 4/27/79 = 98.5

FIGURE 3



DRAINAGE BASIN PLAN

FIGURE 4

APPENDIX A

FIELD INSPECTION REPORT

CHECK LIST
VISUAL INSPECTION

PHASE 1

Name Dam St. James Lake Dam County Jefferson State New York ID # 779

Type of Dam Earth Fill Hazard Category LOW HAZARD A - N.Y.S. Dam Inspection Report 5-29-75

Date(s) Inspection 5-2-79 Weather Fair Temperature 60-65

Pool Elevation at Time of Inspection 98.5 Assumed Datum Tailwater at Time of Inspection ---

Inspection Personnel:

N. Dunlevy	Stetson-Dale	
D. McCarthy	Stetson-Dale	
F.W. Byszewski	Stetson-Dale	

N. Dunlevy Recorder

CONCRETE/MASONRY DAMS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
ANY NOTICEABLE SEEPAGE	No N/A.	
STRUCTURE TO ABUTMENT/EMBANKMENT JUNCTIONS	No N/A.	
DRAINS	No N/A.	
WATER PASSAGES	No N/A.	
FOUNDATION	No N/A.	

CONCRETE/MASONRY DAMS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS CONCRETE SURFACES	N/A.	
STRUCTURAL CRACKING	N/A.	
VERTICAL & HORIZONTAL ALIGNMENT	N/A.	
MONOLITH JOINTS	N/A.	
CONSTRUCTION JOINTS	N/A.	
STAFF GAGE OF RECORDER	N/A.	

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS	None.	
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE	None.	
SLOUGHING OR EROSION OF EMBANKMENT AND ABUTMENT SLOPES	None.	
VERTICAL AND HORIZONTAL ALINEMENT OF THE CREST	No problems observed.	
RIPRAP FAILURES	No riprap.	

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
JUNCTION OF EMBANKMENT AND ABUTMENT, SPILLWAY AND DAM	No problems observed.	
ANY NC ICEABLE SEEPAGE	No East embankment toe area. Substantial flow observed. Believed to be under-dam flow.	Should be investigated. If further seepage exists it should be repaired.
STAFF GAGE AND RECORDER	None.	
DRAINS	None.	

UNGATED SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE WEIR	Stop planks. Some spalling on head-wall and between steel pipe.	
APPROACH CHANNEL	Head of dam.	
DISCHARGE CHANNEL	Concrete lined channel beyond twin steel pipe culvert. Channel well graded.	Cavity at base of lined channel. 10 feet across and 3-4 feet high. Also crack in east headwall at downstreem face of dam.
BRIDGE AND PIERS	Road over dam. No bridges or piers.	

GATED SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE SILL	None.	
APPROACH CHANNEL	None.	
DISCHARGE CHANNEL	None.	
BRIDGE AND PIERS	None.	
GATES AND OPERATION EQUIPMENT	None.	

OUTLET WORKS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CRACKING AND SPALLING OF CONCRETE SURFACES IN OUTLET CONDUIT	See spillway.	
INTAKE STRUCTURE	See spillway.	
OUTLET STRUCTURE	See spillway.	
OUTLET CHANNEL	See spillway.	
EMERGENCY GATE	See spillway.	

DOWNSTREAM CHANNEL

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONDITION (OBSTRUCTIONS, DEBRIS, ETC.)	Obstructed with fallen trees, debris, and rocks.	
SLOPES	Flatly sloped.	
APPROXIMATE NO. OF HOMES AND POPULATION	None. Main road crossed below dam.	

INSTRUMENTATION

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
MONUMENTATION/SURVEYS	None.	
OBSERVATION WELLS	None.	
WEIRS	None.	
PIEZOMETERS	None.	
OTHER	None.	

RESERVOIR

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SLOPES	Slightly graded terrain into reservior.	
SEDIMENTATION	None observed.	

CHECK LIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION
PHASE 1

NAME OF DAM St. James Lake Dam

ID #

ITEM	REMARKS
AS-BUILT DRAWINGS	None.
REGIONAL VICINITY MAP	See this report.
CONSTRUCTION HISTORY	No data.
TYPICAL SECTIONS OF DAM	See information prepared for this report.
OUTLETS - PLAN - DETAILS - CONSTRAINTS - DISCHARGE RATINGS	No data.
RAINFALL/RESERVOIR RECORDS	No data.

ITEM	REMARKS
DESIGN REPORTS	None available.
GEOLOGY REPORTS	None available.
DESIGN COMPUTATIONS HYDROLOGY & HYDRAULICS DAM STABILITY SEEPAGE STUDIES	None available.
MATERIALS INVESTIGATIONS BORING RECORDS LABORATORY FIELD	None available.
POST-CONSTRUCTION SURVEYS OF DAM	None available.
BORROW SOURCES	Unknown.

ITEM	REMARKS
MONITORING SYSTEMS	None.
MODIFICATIONS	Unknown. Some modification has taken place since original construction.
HIGH POOL RECORDS	No data.
POST CONSTRUCTION ENGINEERING STUDIES AND REPORTS	No data.
PRIOR ACCIDENTS OR FAILURE OF DAM DESCRIPTION REPORTS	No data.
MAINTENANCE OPERATION RECORDS	No data.

ITEM	REMARKS
SPILLWAY PLAN SECTIONS DETAILS	No data.
OPERATING EQUIPMENT PLANS & DETAILS	No data.

CHECK LIST
HYDROLOGIC & HYDRAULIC
ENGINEERING DATA

DRAINAGE AREA CHARACTERISTICS: 5.137 square miles.

ELEVATION TOP NORMAL POOL (STORAGE CAPACITY): 511.0

ELEVATION TOP FLOOD CONTROL POOL (STORAGE CAPACITY): ----

ELEVATION MAXIMUM DESIGN POOL: ----

ELEVATION TOP DAM: 517.0

CREST: Only spillway in a service spillway. No overflow emergency spillway.

a. Elevation 511.0
b. Type Weir drop inlet into twin 42 inch pipes.
c. Width ----
d. Length ----
e. Location Spillover Center of dam
f. Number and Type of Gates None

OUTLET WORKS: None

a. Type ----
b. Location ----
c. Entrance Inverts ----
d. Exit Inverts ----
e. Emergency Draindown Facilities ----

HYDROMETEOROLOGICAL GATES:

a. Type ----
b. Location ----
c. Records ----

MAXIMUM NON-DAMAGING DISCHARGE: ----

APPENDIX B

PREVIOUS INSPECTION REPORTS/RELEVANT CORRESPONDENCE

NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION
DAM INSPECTION REPORT
(By Visual Inspection)

Recreation pond at Camp Drum

Dam Number	River Basin	Town	County	Hazard Class*	Date & Inspector
455	Os'chie	Le Ray	Jefferson	A	8/29/25 8VE KH

Type of Construction

- [ ] Earth w/concrete spillway
- [ ] Earth w/drop inlet pipe
- [x] Earth w/stone or riprap spillway
- [ ] Concrete
- [ ] Stone
- [ ] Timber

Use

- [ ] Water Supply
- [ ] Power
- [x] Recreation
- [ ] Fish and Wildlife
- [ ] Farm Pond
- [ ] No Apparent Use-Abandoned

Estimated Impoundment Size

- [x] 1-5 acres
- [ ] 5-10 acres
- [ ] Over 10 acres

Estimated Height of Dam above Streambed

- [x] Under 10 feet
- [ ] 10-25 feet
- [ ] Over 25 feet

Condition of Spillway

- [x] Service satisfactory
- [ ] In need of repair or maintenance

none
- [ ] Auxiliary satisfactory
- [ ] In need of repair or maintenance

Explain: ______

Condition of Non-Overflow Section

- [x] Satisfactory
- [ ] In need of repair or maintenance Explain: ______

Condition of Mechanical Equipment

- [ ] Satisfactory none
- [ ] In need of repair or maintenance Explain: ______

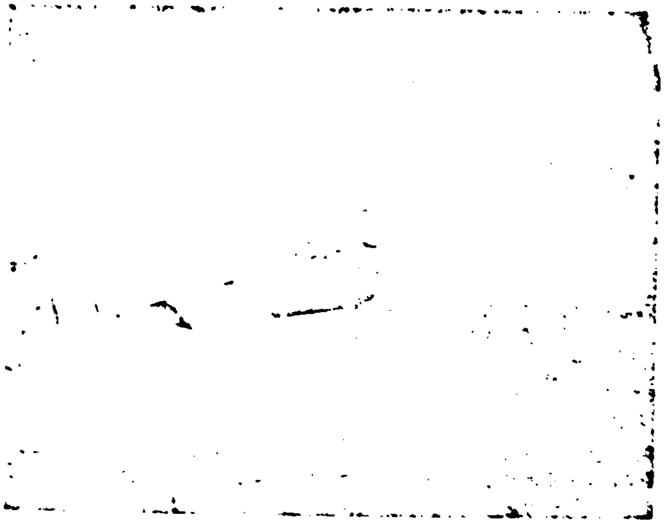
Evaluation (From Visual Inspection)

- [x] No defects observed beyond normal maintenance
- [ ] Repairs required beyond normal maintenance

*Explain Hazard Class, if Necessary ______

' ENVIRONMENTAL CONSERVATION
TION REPORT
Inspection)

Recreation Pond
at Camp Drum



County	Hazard Class*	Date & Inspector
Jefferson	A	8/29/75 RVE KK

Use

- ☐ Water Supply
- ☐ Power
- ☒ Recreation
- ☐ Fish and Wildlife
- ☐ Farm Pond
- ☐ No Apparent Use-Abandoned
- ☐ Timber

Estimated Impoundment Size

- ☒ 1-5 acres
- ☐ 5-10 acres
- ☐ Over 10 acres

Estimated Height of Dam above Streambed

- ☒ Under 10 feet
- ☐ 10-25 feet
- ☐ Over 25 feet

Condition of Spillway

- ☒ Service satisfactory
- ☐ In need of repair or maintenance
- ☐ Auxiliary satisfactory none
- ☐ In need of repair or maintenance

Explain: ____________________

Condition of Non-Overflow Section

- ☒ Satisfactory
- ☐ In need of repair or maintenance Explain: ____________________

Condition of Mechanical Equipment

none

- ☐ Satisfactory
- ☐ In need of repair or maintenance Explain: ____________________

Evaluation (From Visual Inspection)

- ☒ No defects observed beyond normal maintenance
- ☐ Repairs required beyond normal maintenance

*Explain Hazard Class, if Necessary ____________________

3-1&22-1000 (6-2749)

STATE OF NEW YORK
DEPARTMENT OF

State Engineer and Surveyor

ALBANY

Received Jan 31st 1923 Dam No. 455 Oswegatchie Watershed

Disposition Serial No.

Site inspected

Foundation inspected

Structure inspected

Application for the Construction or Reconstruction of a Dam

Application is hereby made to the State Engineer, Albany, N. Y., in compliance with the provisions of Chapter LXV of the Consolidated Laws and Chapter 647, Laws of 1911, Section 22 as amended, for the approval of specifications and detailed plans, marked

herewith submitted for the {~~construction~~ / reconstruction} of a dam located as stated below. All provisions of law will be complied with in the erection of the proposed dam.

1. The dam will be on branch of in the town of , County of and
(Give exact distance and direction from a well-known bridge, dam, village, main cross-roads or mouth of a stream)

2. The name and address of the owner is

3. The dam will be used for

4. Will any part of the dam be built upon or its pond flood any State lands?

5. The watershed at the proposed dam draining into the pond to be formed thereby is square miles.

6. The proposed dam will have a pond area at the spillcrest elevation of acres and will impound cubic feet of water.

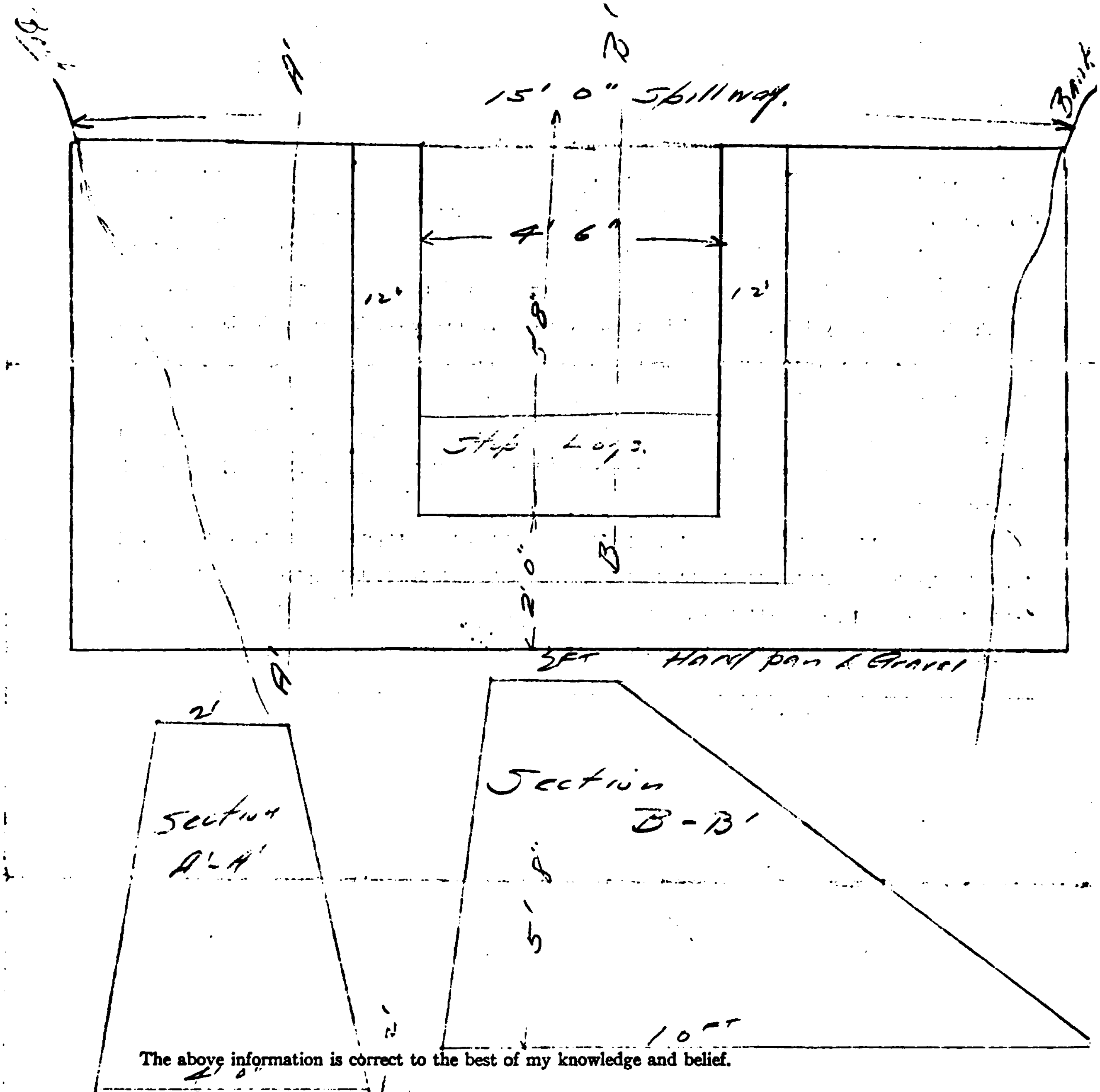
7. The lowest part of the natural shore of the pond is 3 feet vertically above the spillcrest, and everywhere else the shore will be at least 3 feet above the spillcrest.

8. The maximum known flow of the stream at the dam site was cubic feet per second on (Date)

9. State if any damage to life or to any buildings, roads or other property could be caused by any possible failure of the proposed dam

10. The natural material of the bed on which the proposed dam will rest is (clay, sand, gravel, boulders, granite, shale, slate, limestone, etc.)

B-3



The above information is correct to the best of my knowledge and belief.

(Address of signer)

Frank Hibbard
Watertown N.Y.

(Date)

(A person signing for Applicant should indicate his title or authority).

F-15-22-1000 (6-2749)

STATE OF NEW YORK

DEPARTMENT OF

State Engineer and Surveyor

ALBANY

Received Jan 5th 1923 Dam No. 455 Oswegatchie Watershed

Disposition Serial No. 489

Site inspected

Foundation inspected

Structure inspected

Application for the Construction or Reconstruction of a Dam

Application is hereby made to the State Engineer, Albany, N. Y., in compliance with the provisions of Chapter LXV of the Consolidated Laws and Chapter 647, Laws of 1911, Section 22 as amended, for the approval of specifications and detailed plans, marked no plans or specifits,

herewith submitted for the {~~construction~~ / reconstruction} of a dam located as stated below. All provisions of law will be complied with in the erection of the proposed dam.

1. The dam will be on ~~branch of~~ Pleasant Creek in the town of LeRay, County of Jefferson and about 1/8 mile from LeRaysville & 700 S.E. of County Road
(Give exact distance and direction from a well-known bridge, dam, village, main cross-roads or mouth of a stream)

2. The name and address of the owner is Frank Hibbard - Watertown NY

3. The dam will be used for Fish pond

4. Will any part of the dam be built upon or its pond flood any State lands? no

5. The watershed at the proposed dam draining into the pond to be formed thereby is a few acres square miles.

6. The proposed dam will have a pond area at the spillcrest elevation of one acres 8 feet deep. and will impound cubic feet of water.

7. The lowest part of the natural shore of the pond is level with feet vertically above the spillcrest, and everywhere else the shore will be at least level feet above the spillcrest.

8. The maximum known flow of the stream at the dam site was cubic feet per second on Very small
(Date)

9. State if any damage to life or to any buildings, roads or other property could be caused by any possible failure of the proposed dam None

10. The natural material of the bed on which the proposed dam will rest is (clay, sand, gravel, boulders, granite, shale, slate, limestone, etc.) Clay & gravel

B-5

11. The material of the right bank, in the direction with the current, is Clay; at the spillcrest elevation this material has a top slope of ...... inches vertical to a foot horizontal on the center line of the dam, a vertical thickness at this elevation of ...... feet, and the top surface extends for a vertical height of ...... feet above the spillcrest.

12. The material of the left bank is Clay; has a top slope of ...... inches to a foot horizontal, a thickness of ...... feet, and a height of ...... feet.

13. State the character of the bed and the banks in respect to the hardness, perviousness, water bearing, effect of exposure to air and to water, uniformity, etc. Sand

14. If the bed is in layers, are the layers horizontal or inclined? ...... If inclined what is the direction of the slope relative to the center line of the dam and the inches vertical to a foot horizontal? ......

15. What is the thickness of the layers? ......

16. Are there any porous seams or fissures? no

17. **Wastes.** The spillway of the above proposed dam will be 4.6 feet long in the clear; the waters will be held at the right end by a concrete dam the top of which will be 2 feet above the spillcrest, and have a top width of 3 feet; and at the left end by a Concrete dam the top of which will be 2 feet above the spillcrest, and have a top width of 3 feet.

18. There will be also for flood discharge a pipe ...... inches in diameter and the bottom will be ...... feet below the spillcrest, a sluice or gate ...... feet wide in the clear by ...... feet high, and the bottom will be ...... feet below the spillcrest. Plank Gates

19. **Apron.** Below the proposed dam there will be an apron built of concrete, 10 feet long, 4.6 feet wide and 1 feet thick. The downstream side of the apron will have a thickness of ...... feet for a width of ...... feet.

20. **Plans.** Each application for a permit of a dam over 12 feet in height must be accompanied by a location map and complete working drawings of the proposed structure. Each drawing should have a title giving the parts shown, the name of the town and county in which the dam site is located, and the name of the owner and of the engineer.

The location map (U. S. Geological Quadrangle or other map) should show the exact location of the proposed dam; of buildings below the dam which might be damaged by any failure of the dam; of roads adjacent to or crossing the stream below the dam, giving the lowest elevation of the roadway above the stream bed and giving the shape, the height and the width of stream openings; and of any embankments or steep slopes that any flood could pass over. Also indicate the character and use made of the ground.

The complete working drawings should give all the dimensions necessary for the calculations of the stability of the structure, and all the information asked for below under "Sketches." There may be attached to the plans any written reports, calculations, investigations or opinions that may aid in showing the data and method used by the designer.

21. SKETCHES. For small and unimportant structures, if plans have not been made, on the back sheet of this application make a sketch to scale for each different cross-section at the highest point; showing the height and the depth from the surface of the foundation, the bottom width, the top width (for a concrete or masonry spill at 18 inches below the crest), the elevation of the top in reference to the spillcrest, the length of the section, and the material of which the section is to be constructed. Mark each section with a capital letter. Also sketch a plan; show the above sections by their top lines, giving the mark and the length of each; the openings by their horizontal dimensions; and the abutments by their top width and top lengths from the upstream face of the spillcrest and give the elevation of the top in reference to the spillcrest.

22. ELEVATIONS. Also give the elevations, if possible from the Mean Sea Level, of at least two permanent Bench Marks; of the spillcrest for any existing dam on the proposed dam site, at the middle and at both ends of the spill; and of the spillcrest for the above proposed dam.

23. SAMPLES. When so instructed, send samples of the materials to be used in the construction of the proposed dam, using shipping tags which will be furnished. For sand one-half a cubic foot is desired; for cement, three pints; and for the natural bed, twenty cubic inches.

24. INSPECTION. State how inspection is to be provided for during construction By owner

The above information is correct to the best of my knowledge and belief.

608 Davidson St
Watertown NY

(Address of signer)

Frank Hibbard

January 3rd 1923

(Date)

(A person signing for Applicant should indicate his title or authority).

B-8

R-9

AMcK-F.

February 1, 1923.

Dam 455, Oswegatchie,
Leraysville.

Hon. John N. Carlisle,
P. O. Box 18,
Watertown, N. Y.

Dear Sir:

We have received your letter of January 29th, enclosing a second application for the construction of a dam known on our records as No. 455, Oswegatchie Watershed.

The dam will be on a tributary to Pleasant creek, which tributary crosses the county road to Philadelphia and Antwerp at a distance of 1/2 mile northeast from Leraysville four corners, and the dam will be 700 feet above the crossing.

As the area draining into the pond to be formed by the proposed dam will not exceed one square mile; as the dam is but 7'-6" above the natural bed of the stream; as probably the dam does not impound 1,000,000 gallons of water, and as you state in the application received on January 5th, that no possible failure of the proposed dam could do any damage to life, or to buildings, roads, or other property, therefore, in our judgment it is not necessary to prescribe any conditions for safeguarding life and property against danger therefrom, and insofar as the matter concerns the jurisdiction conferred upon this office by Chapter LXV of the Consolidated Laws and Chapter 647 of the Laws of 1911, Section 22, you may complete the work described in the two applications.

This approval shall not be deemed to authorize any invasion of property rights, either public or private, in carrying out the above work; nor to create any claim against the State of New York; nor to be considered as authorizing the flooding of State lands, nor as acquiescing in the flooding of such lands; nor to waive any requirement of Article IX of the Conservation Law relating to water supply.

Very truly yours,

....
Deputy State Engineer.

ALEXANDER MACDONALD
COMMISSIONER
C. TRACEY STAGG
DEPUTY COMMISSIONER
ROBERT F. PRESCOTT
SECRETARY

IN REPLYING PLEASE REFER TO FILE NO.

STATE OF NEW YORK

CONSERVATION COMMISSION

ALBANY

DIVISION OF FISH AND GAME
LLEWELLYN LEGGE, CHIEF
DIVISION OF LAND AND FORESTS
C. R. PETTIS, SUPERINTENDENT
DIVISION OF SARATOGA SPRINGS
J. G. JONES, SUPERINTENDENT
SARATOGA SPRINGS, N. Y.

February 5, 1923.

Hon. Dwight B. LaDu,
State Engineer,
Albany, N. Y.

ATTENTION OF MR. ARNOLD CHAPMAN

Dear Sir:-

I am directed by Commissioner Macdonald to acknowledge receipt of your letter of February 2nd addressed to him, making inquiry as to whether the Commission will require a fishway in a dam which is to be constructed by Mr. Frank Hibbard, Watertown, N. Y., on a tributary to Pleasant Creek.

In reply we would advise you that the Commission will not require the placing of a fishway in this dam at the present time, reserving the right, however, to have such fishway placed in the dam in the future if we believe it necessary.

Very truly yours,

Alexander Macdonald, Commissioner.

37

John T. McCormick

Deputy Chief, D.F.G.C.C.

JTM.T

B-11

ARMcK-F.

February 2, 1923.

Dam No. 455, Oswegatchie
Watershed.

Hon. Alexander Macdonald,
Conservation Commissioner,
Albany, N. Y.

Dear Sir:

Mr. Frank Hibbard of Watertown, N. Y., wishes to erect a concrete dam approximately 8 feet high, which will be on a tributary to Pleasant creek, which tributary crosses the county road from Leraysville to Philadelphia and at a distance 1/2 mile northeast from Leraysville four corners. The dam will be 700 ft. above the crossing, and its location is shown on U. S. G. S. Sheet No. 88. Will this dam require a fishway?

Very truly yours,

....
Deputy State Engineer.

B-12

Office of the President

Northern New York Utilities, Inc.

John N. Carlisle

Watertown, N.Y. Jan. 29, 1923.

REF'D TO..........
ANS'D..........

Hon. Dwight B. LaDu,
State Engineer's Office,
Albany, N. Y.

Dam No. 455, Oswegatchie-LeRaysville.

Dear Sir:-

I have your favor of January 5th acknowledging receipt of my letter of January 4th, concerning the construction of a dam half a mile northeast of LeRaysville Four Corners, and in accordance with your request I am returning you the application which you ~~I~~ sent me ~~you~~ with the sketch on the back thereof, and which I trust will give you the information you desire. This sketch should be attached to the other application which I sent you in my latter of January 4th, and that contained the other information.

As I understand, you grant the licenses in connection with these matters, and as I wrote you before, this is a very small dam and could possibly result in no damages, and I am simply doing the work for an old friend of mine, who is trying to establish a trout pond.

Yours very truly,

J N Carlisle

JNC/B
Encl.

B-13

AMcK-P.

January 5, 1920.

Dam No. 455, Oswegatchie,
Leraysville.

Hon. John N. Carlisle,
P. O. Box No. 18,
Watertown, N. Y.

Dear Sir:

We have received your letter of January 4th, concerning the construction of a dam half a mile northeast of Leraysville Four Corners.

On the enclosed application kindly make the sketches requested in section 21. On the spillway section show a cross section of the apron with its width, thickness and material, and show the abutment or wash wall at the end of the spillway, giving its height and thickness. Also sketch the elevation of the ends of the dam with cross section of banks, giving the depth and width excavated into the banks. On the plan outline the apron, giving its length.

Very truly yours,

....
State Engineer.

Enclosure.

B-14

Office of the President

Northern New York Utilities, Inc.

John N. Carlisle

Watertown, N.Y. Jan. 4, 1923.

ARMcK-M

Proposed dam at
Leraysville and
Evans Mills.

Hon. D. B. LaDue,

State Engineer & Surveyor,

Albany, N. Y.

Dear Sir:-

In reference to proposed matter, I have the favor of your office of December 28th, asking us to fill out an application blank in connection with the construction of a dam by Mr. Frank Hibbard.

I am returning the U. S. Geological Survey sheet and questionairre filled out.

You will notice this is a very small matter, and one that could possibly affect no one. If there is any further information about the matter, kindly take it up with me and I will be glad to give you any further details you may want.

Yours very truly,

JNCarlisle

JNC/B
Encl.

B-15

A'D'cM-H

Proposed Dam at
Jerseyville and Evans
Mill:
455 [illegible]

December 2[illegible], 192[illegible].

Hon. John [illegible]. Carlisle,
P. O. Box [illegible],
Watertown, N.Y.

Dear Sir:

Your letter of December 2[illegible]th received stating that Mr. Frank [illegible] of Watertown wishes to construct a dam between Jerseyville and Evans Mill. We enclose herewith U. S. Geological Survey sheet No. [illegible] on which we ask you to mark the exact location of the dam. The scale of the map is one inch to the mile.

Kindly fill out one of the enclosed applications and submit to this office for approval of the work, making the sketches as requested under Section 11 of the application, and on the spillway section show a cross section of the apron with its width, thickness and material; showing the abutment of wash wall at the end of the spillway, giving its width and thickness. Also sketch the elevation of the ends of the dam with cross section of the banks, giving the depth and width extending into the banks. Or if plans are drawn, there should be duplicate prints sent to this department, one of which will be returned if they meet with our approval.

Yours very truly,

[illegible]
State Engineer,

BY

Ass't Deputy.

Enclosures.

B-16

Office of the President

Northern New York Utilities, Inc.

John N. Carlisle

Watertown, N.Y. Dec. 26, 1922.

Alexander Rice McKim, Esq.,
State Conservation Commission,
Albany, N. Y.

My dear Mr. McKim:-

Mr. Frank Hibbard of this city is the owner of a small pond between Leraysville and Evans Mills in this county, and in order to make a trout preserve he has put in a small piece of concrete where there was an old crib dam, and the pond altogether is about an acre and a quarter and the water is about seven feet deep.

He called to see me today, and said that he had been informed that some inspectors, probably from your department, had been up there and stated that he had no right to erect this dam without the approval of your department.

I have known Mr. Hibbard a long while, and he certainly did not intend to do anything contrary to the rules of your department, and of course knew nothing about the law itself. He does not intend to create any power at that place, and I am enclosing you a photograph that shows just what work he has done. Possibly he ought to file some kind of an application with you and have somebody come up, and if you will let me know just what course he ought to pursue, he will be glad to comply with any of your regulations. You can write me direct and I will take it up with him.

There was an old crib dam for years at this place but it went out about six or seven years ago, and the old crib dam has been there for over one hundred years. You will see by the photograph that it is a very small matter, but he wants of course to comply with any regulations necessary.

Yours very truly,

J.N. Carlisle

JNC/B
Encl.

B-17

APPENDIX C

HYDROLOGIC AND HYDRAULIC COMPUTATIONS

STETSON • DALE BANKERS TRUST BUILDING UTICA • NEW YORK • 13501 TEL 315-797-5800 **DESIGN BRIEF**

PROJECT NAME NEW YORK STATE DAM INSPECTION DATE 5·1·79

SUBJECT ST. JAMES LAKE DAM (FORT DRUM, NY) PROJECT NO. 2277

ESTIMATE OF CLARK'S PARAMETERS DRAWN BY JPG

ESTIMATE OF TC

ASSUME: $R/(T_c+R) = .$

$\therefore R = T_c$ *

$$T_c = 11.9 \, (L^3/H)^{.385}$$

	L (MI)	H (FT)	Tc (HRS) & R
SUB AREA 1	.852	95	1.713
" " 2	.568	100	1.052
" " 3	.795	140	1.362
" " 4	.663	155	1.062
" " 5	1.136	50	3.058
" " 6	.341	120	.544

SCS

$$L = \frac{l^{.8}(s+1)^{.7}}{1900\, Y^{.5}} \qquad T_c = L/.6$$

	l (FT)	S	Y (%)	L (HRS)	Tc (HRS) & R
SUB AREA 1	4500	3.89	5	.598	.99
" " 2	3000	4.49	7	.396	.66
" " 3	4200	4.08	7	.491	.82
" " 4	3500	4.92	8	.442	.74
" " 5	6000	1.76	4	.564	.94
" " 6	1800	3.89	8	.227	.38

CN COMPUTATIONS

SUB AREA 2: 85x15 = 1275
66x85 = 5610
6885 ÷ 10 = 69

SUB AREA 3: 85 x 24 = 2040
66 x 76 = 5016
7056 ÷ 10 = 71

SUB AREA 4: 85x14 = 1190
66x86 = 5676
6866 ÷ 10 = 69

* NORTH ATLANTIC REGIONAL WATER RESOURCES STUDY - FEBRUARY 1972

STETSON • DALE BANKERS TRUST BUILDING UTICA • NEW YORK • 13501 TEL 315•797•5800 DESIGN BRIEF

PROJECT NAME New York State Dam Inspection DATE 5.1.79

SUBJECT St James Lake Dam (Fort Drum, NY) PROJECT NO. 2277

Estimate of Snyder's Parameter DRAWN BY JPG

640 C_p

	C_p
Sub Area 1	.625
" " 2	.625
" " 3	.625
" " 4	.625
" " 5	.625
" " 6	.625

$t_p = C_t (L \cdot L_{ca})^{.3}$

	C_t	L (mi)	L_{ca} (mi)	t_p
Sub Area 1	2.0	.852	.378	1.424
" " 2	2.0	.568	.426	1.307
" " 3	2.0	.795	.473	1.491
" " 4	2.0	.663	.568	1.492
" " 5	2.0	1.136	.568	1.754
" " 6	2.0	.341	.284	.993

$t_r = t_p/5.5$

	t_p	t_r
Sub Area 1	1.424	.259
" " 2	1.307	.238
" " 3	1.491	.271
" " 4	1.492	.271
" " 5	1.754	.319
" " 6	.993	.181

$t_{pr} = t_p + .25 (t_R - t_r)$

	t_p	t_R	t_r	t_{pr}
Sub Area 1	1.424	1.0	.259	1.61
" " 2	1.307	1.0	.238	1.50
" " 3	1.491	1.0	.271	1.67
" " 4	1.492	1.0	.271	1.67
" " 5	1.754	1.0	.319	1.92
" " 6	.993	1.0	.181	1.20

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PROJECT NAME New York State Dam Inspection DATE 5·3·79
SUBJECT St James's Lake Dam (Fort Drum, NY) PROJECT NO. 2277
Depth - Duration Relationship DRAWN BY JPG

Hydrometeorological Report Nº 33

PMP Index Rainfall
200 Sq Mi
24 Hr - 18.5"

Duration	%	Depth
6 Hr	111	20.54
12 Hr	123	22.76
24 Hr	133	24.61
48 Hr	142	26.50

ST JAMES LAKE - STA. 5 (BELOW DAM) #2277

STAGE DISCHARGE CALCULATIONS by AMS

5/18/79

SUMMARY

HEIGHT ABOVE CULVERT INVERT. (FT)	TOTAL DISCHARGE (CFS)	
0	0	MANNING FLOW WITH ASSUMED SLOPE (UNABLE TO VERIFY)
1	25	
2	70	
3	125	
4	185	
5	250	
6	360	ASSUMED INLET CONTROL GOVERNS CULVERT FLOW (UNABLE TO VERIFY)
7	440	
8	500	
9	600	
10	700	
11	800	
12	850	
13	980	EMBANKMENT OVERTOPPED
14	1,470	
15	2,345	
16	3,680	
17	5,260	
18	7,410	
19	9,900	
20	12,770	
21	15,980	

CULVERT INVERT = 72.64' (±)

MINIMUM EMBANKMENT ELEV. = 84.8' ±

for $h = 1'$ elev = 73.64' , flow through culvert only

$$Q = VA = A \frac{1.49}{n} R^{2/3} S^{1/2}$$

$S = .03'/70' = \cancel{.00043}$, let $S \cong .001 \therefore S^{1/2} = .032$

$A = 1' \times 8' = 8\ ft^2$

$R = A/p = 8\ ft^2/10' = .80,\ R^{2/3} = .86$

$$= 8\ ft^2 \times \frac{1.49}{.013} \times 0.86 \times .032 = 25.2\ cfs \cong 25^{\pm}\ cfs$$

for $h = 2'$, elev = 74.64'

$$Q = VA = A \frac{1.49}{n} R^{2/3} S^{1/2}$$

$A = 2 \times 8'\quad 16\ ft^2$

$R = A/p = 16/12 = 1.\overline{33}\ ;\ R^{2/3} = 1.21$

$$= 16\ ft^2 \times \frac{1.49}{.013} \times 1.21 \times .032 = 70.9 \cong 70^{\pm}\ cfs$$

for $h = 3'$, elev = 75.64'

$$Q = VA = A \frac{1.49}{n} R^{2/3} S^{1/2}$$

$A = 3' \times 8' = 24\ sf$

$R = A/p = 24/14 = 1.71,\ R^{2/3} = 1.43$

$$= 24 \times \frac{1.49}{.013} \times 1.43 \times .032 = 126 \cong 125^{\pm}\ cfs$$

for $h = 4'$, elev = 76.64

$$Q = VA = A \frac{1.49}{n} R^{2/3} S^{1/2}$$

$A = 4 \times 8 = 32$

$R = 32/16 = 2.0\quad R^{2/3} = 1.59$

$$= 32 \times \frac{1.49}{.013} \times 1.59 \times .032 = 186 \cong 185^{\pm}\ cfs$$

for $h = 5'$, elev = 77.64

$$Q = VA = A \frac{1.49}{n} R^{2/3} S^{1/2}$$

$A = 5 \times 8 = 40$

$R = 40/18 = 2.\overline{22}\quad R^{2/3} = 1.70$

$$= 40 \times \frac{1.49}{.013} \times 1.70 \times .032 = 249 \cong 250^{\pm}\ cfs$$

for $h = 6'$, elev 78.64

switch to fig. 3, assume inlet control beginning to govern at this flat gradient.

for $HW/S_p = 6/8.15 = .74$, $Q = 45$ cfs/ft

$= \underline{360 \text{ cfs}}$

for $h = 7'$, elev 79.64

for $HW/S_p = 7/8.15 = .86$, $Q = 55$ cfs/ft

$= \underline{440 \text{ cfs}}$

for $h = 8'$, elev 80.64

for $HW/S_p = 8/8.15 = .98$ $Q = 63$ cfs/ft

$= 504$ cfs $\approx \underline{500 \text{ cfs}}$

for $h = 9'$, elev 81.64

for $HW/S_p = 9/8.15 = 1.10$ $Q = 75$ cfs/ft

$= \underline{600 \text{ cfs}}$

$h = 10'$, elev 82.64

for $HW/S_p = 10/8.15 = 1.23$ $Q = 87$ cfs/ft

$= \underline{700 \text{ cfs}}$

for $h = 11'$, elev 83.64

for $HW/S_p = 11/8.15 = 1.35$ $Q = 99$ cfs/ft

$= \underline{800 \text{ cfs}}$

for $h = 12'$, elev 84.6 (no overtopping yet)

for $HW/S_p = 12/8.15 = 1.47$, $Q = 106$ cfs/ft

$= \underline{850 \text{ cfs}}$

for $h = 13'$, elev $= 85.6$ (embankment overtopped by .8')

culvert; for $HW/S_p = 13/8.15 = 1.60$, $Q = 113 \times 8 = 900$ cfs

weir; $Q_w = \Sigma\, CLH^{3/2} = 1.45\left[40 \times .2^{3/2} + 100 \times .6^{3/2} + 50 \times .2^{3/2}\right]$

$= 1.45\left[3.6 + 46.5 + 4.5\right] = 79.2 = 80$ cfs

$Q_{TOT} = Q_w + Q_c = 900 + 80 = \underline{980 \text{ cfs}}$

for $h = 14'$, elev $= 86.6$ (overtopped by 1.8)

culvert, for $HW/S_p = 14/8.15 = 1.72$, $Q = 121 \times 8 \cong 970$ cfs

weir; $Q = \Sigma\, CLH^{3/2} = 1.45\left[35 \times .3^{3/2} + 50 \times 1.1^{3/2} + 100 \times 1.6^{3/2} + 50 \times 1.2^{3/2} + 40 \times .5^{3/2}\right] = 1.45\left[5.6 + 57.7 + 202.4 + 65.7 + 14.1\right] = 501 = 500$ cfs

$Q_{TOT} = Q_W + Q_c = 970 + 500 = \underline{1470 \text{ cfs}}$

for $h = 15'$, elev $= 87.6$ (overtopped by 2.8)

culvert, for $HW/S_p = 15/8.15 = 1.84$ - $Q = 129 \times 8 = 1030$ cfs

weir, $Q = \Sigma\, CLH^{3/2} = 1.45\left[30 \times .4^{3/2} + 50 \times 1.3^{3/2} + 50 \times 2.1^{3/2} + 100 \times 2.6^{3/2} + 50 \times 2.2^{3/2} + 50 \times 1.4^{3/2} + 30 \times .5^{3/2}\right]$

$= 1.45\left[7.6 + 70.3 + 152.2 + 419.2 + 163.2 + 82.8 + 10.6\right]$

$= 1314$ cfs $= 1315$ cfs

$Q_{TOT} = Q_w + Q_c = 1030 + 1315 = \underline{2345 \text{ cfs}}$

for $h = 16'$, elev = 88.6 (overtopping by 3.8')

culvert, for $HW/_{D} = 16/8.15 = 1.96$ $Q = 135 \times 8 = 1080$

weir; $Q = \Sigma CLH^{3/2} = 1.45 [20 \times .1^{3/2} + 50 \times 1.2^{3/2} + 50 \times 2.2^{3/2} + 50 \times 3.1^{3/2} +$
$100 \times 3.6^{3/2} + 50 \times 3.2^{3/2} + 50 \times 2.4^{3/2} + 50 \times 1.2^{3/2} + 20 \times .2^{3/2}]$
$= 1.45 [.6 + 65.7 + 163.2 + 272.9 + 683.1 + 286.2 + 185.9 +$
$67.2 + 1.8] = 2504 \cong 2500$ cfs

$Q_{TOT} = Q_{cu} + Q_{w} = 1080 + 2500 = \underline{\underline{3680 \text{ cfs}}}$

for $h = 17'$, elev = 89.6 (overtopping by 4.8')

culvert; for $HW/_{D} = 17/8.15 = 2.09$ $Q = 140 \times 8 = 1120$ cfs

weir; $Q_w = \Sigma CLH^{3/2} = 1.45 [10 \times .1^{3/2} + 50 \times .9^{3/2} + 50 \times 2.2^{3/2} + 50 \times 3.2^{3/2}$
$+ 50 \times 4.1^{3/2} + 100 \times 4.6^{3/2} + 50 \times 4.2^{3/2} + 50 \times 3.4^{3/2} + 50 \times 2.2^{3/2} + 40 \times 1.2^{3/2}]$
$= 1.45 [.3 + 42.7 + 163.2 + 286.2 + 415.1 + 986.6 + 430.4 +$
$313.5 + 163.2 + 52.6] = 4138 \approx 4140$ cfs

$Q_{TOT} = Q_c + Q_w = 1120 + 4140 = \underline{\underline{5260 \text{ cfs}}}$

for $h = 18'$ elev = 90.6 (overtopping by 5.8')

culvert, for $HW/_{D} = 18/8.15 = 2.20$ $Q = 149 \times 8 = 1190$ cfs

weir; $Q_w = \Sigma CLH^{3/2} = 1.45 [35 \times .6^{3/2} + 50 \times 1.9^{3/2} + 50 \times 3.2^{3/2} + 50 \times 4.2^{3/2} +$
$50 \times 5.1^{3/2} + 100 \times 5.6^{3/2} + 50 \times 5.2^{3/2} + 50 \times 4.4^{3/2} + 50 \times 3.2^{3/2} + 50 \times 2.4^{3/2}$
$+ 15 \times .1^{3/2}] = 1.45 [16.3 + 130.9 + 286.2 + 430.4 +$
$575.9 + 1325.2 + 592.9 + 461.5 + 286.2 + 185.9 + .5]$
$= 6223 \pm$

$Q_{TOT} = Q_c + Q_w = 1190 + 6220 = 7410$ cfs

for $h = 19'$, elev = 91.6 (overtopping by 6.8')

culvert; for $HW/S = 19/8.15 = 2.33$, $Q = 152 \times 8 = 1210$ cfs

weir; $Q_w = \Sigma CLH^{3/2} = 1.45 [10 \times .1^{3/2} + 50 \times 1.5^{3/2} + 50 \times 2.9^{3/2} + 50 \times 4.2^{3/2} + 50 \times 5.2^{3/2} + 50 \times 6.1^{3/2} + 100 \times 6.6^{3/2} + 50 \times 6.2^{3/2} + 50 \times 5.4^{3/2} + 50 \times 4.2 + 50 \times 3.4^{3/2} + 40 \times 1^{3/2}] = 1.45 [.3 + 91.9 + 246.9 + 430.4 + 592.9 + 753.3 + 1695.6 + 771.9 + 627.4 + 430.4 + 313.5 + 40] = 8691$

$Q_{TOT} = Q_c + Q_w = 1210 + 8690 = \underline{9900 \text{ cfs}}$

for $h = 20'$, elev = 92.6 (overtopping by 7.8')

culvert; for $HW/S_p = 20/8.15 = 2.45$ $Q = 160 \times 8 = 1280$

weir; $Q_w = \Sigma CLH^{3/2} = 1.45 [25 \times .7^{3/2} + 50 \times 2.4^{3/2} + 50 \times 3.9^{3/2} + 50 \times 5.2^{3/2} + 50 \times 6.2^{3/2} + 50 \times 7.1^{3/2} + 100 \times 7.6^{3/2} + 50 \times 7.2^{3/2} + 50 \times 6.4^{3/2} + 50 \times 5.2^{3/2} + 50 \times 4.4^{3/2} + 50 \times 1.6^{3/2} + 10 \times .2^{3/2}]$

$= 1.45 [14.6 + 185.9 + 385.1 + 592.9 + 771.9 + 945.9 + 2095.2 + 966.0 + 809.5 + 592.9 + 461.4 + 101.2 + .9]$

$= 11489 \cong 11,490$ cfs

$Q_{TOT} = Q_c + Q_w = 1280 + 11490 = \underline{12,770 \text{ cfs}}$

for $h = 21$, elev = 93.6 (overtopping by 8.8')

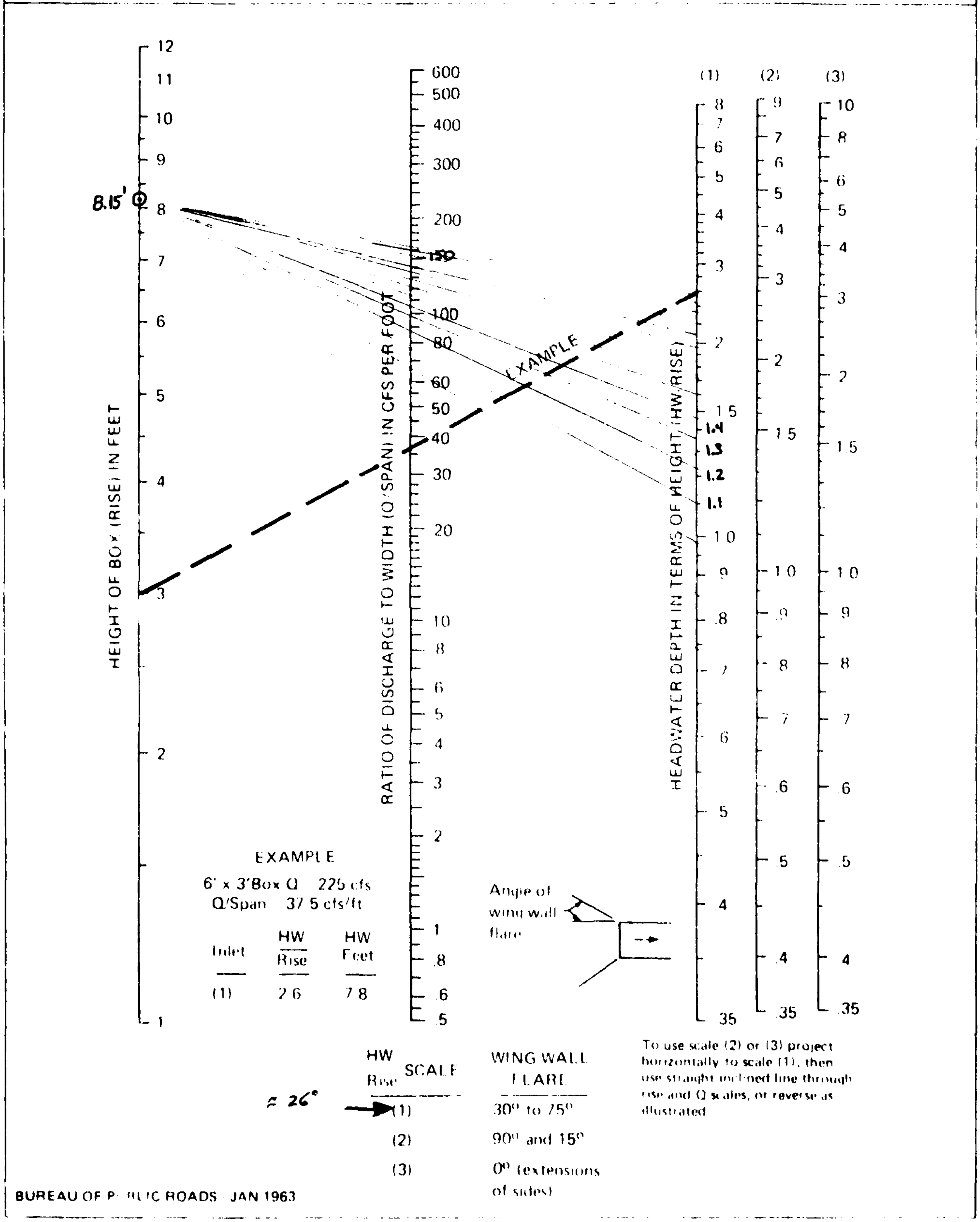
culvert; for $HW/S_p = 21/8.15 = 2.58$ $Q = 162 \times 8 = 1296 = 1300$ cfs

weir; $Q_w = \Sigma CLH^{3/2} = 1.45 [45 \times 1^{3/2} + 50 \times 3.4^{3/2} + 50 \times 4.9^{3/2} + 50 \times 6.2^{3/2} + 50 \times 7.2^{3/2} + 50 \times 8.1^{3/2} + 100 \times 8.6^{3/2} + 50 \times 8.2^{3/2} + 50 \times 7.4^{3/2} + 50 \times 6.2^{3/2} + 50 \times 5.4^{3/2} + 50 \times 2.6^{3/2} + 35 \times .8^{3/2}]$

$= 1.45 [45 + 313.5 + 542.3 + 771.9 + 966.0 + 1152.6 + 2522.0 + 1174.1 + 1006.5 + 771.9 + 627.4 + 209.6 + 25.0] = 14,685$ cfs

$Q_{TOT} = Q_c + Q_w = 1300 + 14,680 = 15,980$ cfs

FIGURE 3: Headwater Depth for Concrete Box Culverts With Inlet Control



ST. JAMES LAKE # 2277

STAGE DISCHARGE CALCULATIONS

by AMS

5/4/79

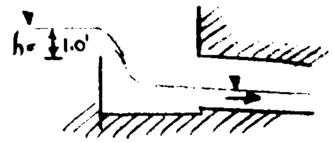
SUMMARY

HEIGHT ABOVE NORMAL POOL (FT)	TOTAL DISCHARGE (CFS)	
0	0	
1.0	28	
2.0	100	WEIRS SUBMERGED, INLET CONTROL
3.0	151	
4.0	185	
5.0	278	EMBANKMENT OVERTOPPED
6.0	569	
7.0	1078	
8.0	1820	
9.0	2760	
10.0	3930	
11	5280	
12	6830	
13	8590	
14	10,570	
15	12,770	

NORMAL POOL ELEV = 98.5

MINIMUM EMBANKMENT ELEV = 102.6'

for lake elev. = 99.5 $\therefore$ $h = 1.0'$



assume planking acts as sharp edge weir

for sharp crested weir : Francis weir formula (see *Handbook of Applied Hydraulics*, Davis, 1952)

$$Q = C\,\ell\left[(h+h_v)^{3/2} - (h_v)^{3/2}\right] \quad \text{where } h_v \cong 0, \quad C = 3.33$$

$$\ell = \ell' - .1nh$$

$$\therefore \quad Q = 3.33\,\ell\,h^{3/2}$$

for $h = 1.0'$ $\ell = 8.5 - .1 \times 2(1.0)' = 8.3'$ assume weir control

$$Q = 3.33\,(8.3')\,(1.0)^{3/2} = 27.6 \text{ cfs} \approx 28$$

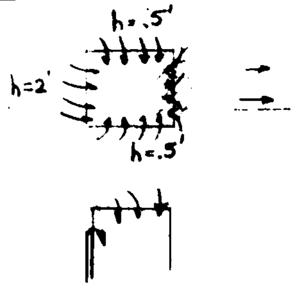
check inlet control on twin 42"ø culverts

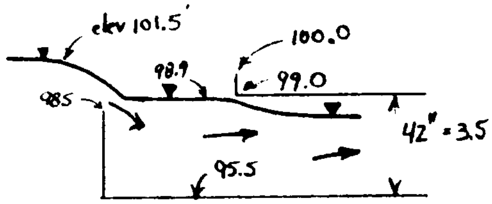
for Q = 28 cfs or 14 cfs each with D = 42" see attached fig.

HW/D ≈ small, flow controlled by amount over weir

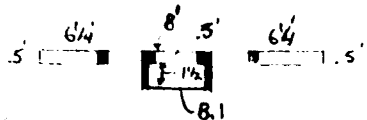
* $\therefore$ for $h = 1.0'$, $Q = 28$ cfs.

<u>for lake elev = 100.5</u> ; $h = 2.0'$





assume weir control ; w/ $h_v = 0$
(Francis submerged weir formula)



Q_T = sharp crested flow + broad crested flow

$$= 3.33\, l h_1^{3/2} + 2 \times 2.8\, l h_2^{3/2} = 3.33\, A_1 h_1^{1/2} + 5.6\, A_2 h_2^{\ }$$

$$= 3.33 \times 16.15\sqrt{2} + 5.6\,(6\tfrac{1}{4})\sqrt{.5} = 76.1 + 24.7 \text{ cfs} = 100.8 \text{ cfs}$$

checking inlet control on twin 42"φ culverts

for Q_T = 101 cfs or 50½ cfs per culvert (42"φ)

then $HW/D = .97$; $HW = 3.4'$ = elev 98.9 one weir partially submerged

correction to Q_T for partially sumerged weir

$$Q_T = 3.33\, l \sqrt{h'}\,(h + .381\, d) + 24.7 \quad \Big\{ \text{where } l \cong 8.2' \;\; h' \cong 1.7, \;\; h = 2.0' \;\; d \cong .3$$

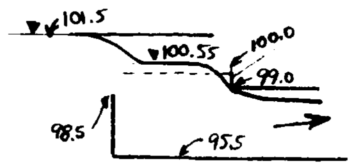
$$= 3.33\;\, 8.2\, \sqrt{1.7}\,(2 + .11) + 24.7$$

$$= 75.1 + 24.7 \text{ cfs} = 99.8 \text{ cfs} \approx 100 \text{ cfs or } 50 \text{ cfs each.}$$

checking HW; see fig 9.21 attached, $HW/D = .96 \pm$

$HW = 3.36'$ close enough

* ∴ for $h = 2.0'$, $Q = 100$ cfs



for lake elev = 101.5', h = 3.0'

assume weirs will be partially submerged

let $h' = .95$ $\therefore$ $h_1 = 3.0'$, $d_1 = 2.05'$

$h_2 = 1.5'$, $d_2 = .55'$

$$Q_T = 3.33\ l_1 \sqrt{h'}\,(h_1 + .381\,d_1) + 2\left[2.8\ l_2 \sqrt{h'}\,(h_2 + .381\,d_2)\right]$$

$$= 3.33\ (7.7'\pm)\sqrt{.95}\ (3 + .78) + 2 \times 2.8 \times 5.75^{\pm} \sqrt{.95} \times (1.5 + .21)$$

$$= 94.4 + 53.7 \text{ cfs} = 148.1 \text{ cfs}$$

checking flow through culverts

if $h' = .95'$, $HW/D = \frac{6.0 - .95}{3.5} = 1.44$

see fig 9.21 attached; $\therefore$ for $HW/D = 1.44$, $Q \cong 77$ cfs each

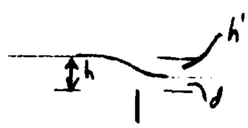
or $Q_T = 2 \times 77 = 154$ cfs

since 148 cfs over weir $\approx$ 154 cfs thru culvert, ✓ OK

at this depth, use Q_T = ave $Q = \frac{154 + 148}{2} = 151$ cfs

* for $h = 3.0'$, $Q_T = 151$ cfs

for lake elev = 102.5, h = 4.0'



assume weirs will be partially submerged

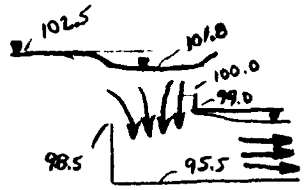
let $h' = .70'$ $\therefore$

$$Q_T = 3.33\ l_1 \sqrt{h'}\,(h_1 + .381\,d_1) + 2 \times 2.8\ l_2 \sqrt{h'}\,(h_2 + .381\,d_2)$$

$$Q_T = 3.33\ \ 7.5' \sqrt{.7}\ (4.0 + 1.26) + 2 \times 2.8 \times 5.25' \times \sqrt{.7}\ (2.5 + .68)$$

$$= 109.9 + 78.2 = 188.1 \text{ cfs} \approx 188 \text{ cfs}$$

(con't)



h = 4.0' (con't)

checking flow through culverts

if $h' = .7'$; then $HW/D = 7.0 - .7/3.5 = 1.8$

see fig 9.21 attached $\therefore Q \cong 91$ cfs

or $Q_T = 2 \times 91 = 182$ cfs

since 188 cfs over weir $\approx$ 182 cfs thru culvert ; ✓ ok

assume equilibrium @ $\bar{Q} = 188 + 182/2 = 185$ cfs

$*$ for $h = 4.0'$, $Q_T = 185$ cfs

for lake elev. = 103.5 ; h = 5.0'

for $h = 5.0'$; embankment overtopped

$Q_{EM} = \Sigma\, C\, L_i H_i^{3/2} = 1.45\left[(7' \times .1^{3/2}) + (30' \times .6^{3/2}) + (30' \times .75^{3/2}) + (30' \times (.5)^{3/2}) + (10' \times .1^{3/2})\right] = 1.45\left[.2 + 13.9 + 19.5 + 10.6 + .3\right] = 64$ cfs

assume head loss over weirs $\cong .3'$ $\therefore HW/D = 8.0 - .3/3.5 = 2.2$

for $HW/D = 2.2$, $Q_{CULV} = 2 \times 107 \frac{cfs}{culv.} = 214$ cfs

$Q_T = Q_{EM} + Q_{CULV.} = 64 + 214 = 278$ cfs

$*$ for $h = 5.0'$, $Q_T = 278$ cfs

for lake elev = 104.5'; h = 6.0'

embankment overtopped by 1.9'

$$Q_{EM} = \Sigma\ CLH^{3/2} = 1.45\,[(5 \times .1^{3/2}) + (30' \times .8^{3/2}) + (30' \times 1.6^{3/2}) + (30' \times 1.75^{3/2}) + (30 \times 1.5^{3/2}) + (30 \times .85^{3/2}) + (12' \times .4^{3/2})] =$$

$$= 1.45\,[.2 + 21.5 + 60.7 + 69.5 + 55.1 + 23.5 + 3.0] = 339 \text{ cfs}$$

assume head loss over weir $\cong .2'$ $\therefore$ $HW/D = \frac{9. - .2}{3.5} = 2.51$

for $HW/D = 2.51$, $Q = 115$ cfs for 42"ϕ

$$Q_{CULV} = 2 \times 115 = 230 \text{ cfs}$$

$$Q_T = Q_{EM} + Q_{CULV} = 339 + 230 = 569 \text{ cfs}$$

* for $h = 6.0'$; $Q_T = 569$ cfs

for lake elev = 105.5, h = 7.0'

embankment overtopped by 2.9'

$$Q_{EM} = \Sigma\ CLH^{3/2} = 1.45\,[30 \times .8^{3/2} + 30 \times 1.8^{3/2} + 30' \times 2.6^{3/2} + 30 \times 2.75^{3/2} + 30 \times 2.5^{3/2} + 30 \times 1.85^{3/2} + 26' \times 1.0^{3/2}] = 1.45\,[21.5 + 72.4 + 126.8 + 136.8 + 118.6 + 75.5 + 26] = 838 \text{ cfs}$$

assume negligible head loss over weirs $\therefore$ $HW/D = 10/3.5 = 2.86$

for $HW/D = 2.86$, $Q = 120$ cfs for 42"ϕ

$$Q_{CULV} = 2 \times 120 = 240 \text{ cfs}$$

$$Q_T = Q_{EM} + Q_{CULV} = 838 + 240 = 1078 \text{ cfs}$$

* for $h = 7.0'$, $Q_T = 1078$ cfs.

(6)

<u>for lake elev = 106.5' ; h = 8.0'</u>

embankment overtopped by 3.9'

$$Q_{EM} = \Sigma\, CLH^{3/2} = 1.45\left[16\times .5^{3/2} + 30\times 1.8^{3/2} + 30\times 2.8^{3/2} + 30\times 3.6^{3/2} + 30\times 3.75^{3/2} + 30\times 3.5^{3/2} + 30\times 2.85^{3/2} + 30\times 1.9^{3/2} + 10\times .4^{3/2}\right]$$

$$= 1.45\left[5.6 + 72.4 + 140.6 + 204.9 + 217.9 + 196.4 + 144.3 + 78.6 + 2.5\right] = 1540 \text{ cfs}$$

for $HW/D = 11/3.5 = 3.14$, $Q = 140$ for $42''\phi$

$$Q_{CULV} = 2 \times 140 = 280 \text{ cfs}$$

$$\therefore = Q_{EM} + Q_{CULV} = 1540 + 280 = 1820 \text{ cfs}$$

* for $h = 8.0'$; $Q_T = 1820$ cfs

<u>for lake elev = 107.5', h = 9.0'</u>

embankment overtopped by 4.9'

$$Q_{EM} = \Sigma\, CLH^{3/2} = 1.45\left[2'\times \cancel{.6}^{\,0} + 30\times 1.3^{3/2} + 30\times 2.8^{3/2} + 30\times 3.8^{3/2} + 30\times 4.6^{3/2} + 30\times 4.75^{3/2} + 30\times 4.5^{3/2} + 30\times 3.85^{3/2} + 30\times 2.9^{3/2} + 20\times 1.3^{3/2}\right]$$

$$= 1.45\left[44.5 + 140.6 + 222.2 + 296.0 + 310.6 + 286.4 + 226.6 + 148.2 + 29.6\right] = 2470 \text{ cfs}$$

for $HW/D = 12/3.5 = 3.43$; $Q = 145$ cfs

$$Q_{CULV} = 2 \times 145 = 290 \text{ cfs}$$

$$Q_T = Q_{EM} + Q_{CULV} = 2470 + 290 = 2760 \text{ cfs}$$

* for $h = 9.0'$, $Q_T = 2760$ cfs

for lake elev = 108.5 ; h = 10.0

embankment overtopped by 5.9'

$Q_{EM} = \Sigma\, CLH^{3/2} = 1.45 [18 \times .5^{3/2} + 30 \times 2.1^{3/2} + 30 \times 3.8^{3/2} + 30 \times 4.8^{3/2} + 30 \times 5.6^{3/2} + 30 \times 5.75^{3/2} +$
$30 \times 5.5^{3/2} + 30 \times 4.85^{3/2} + 30 \times 3.9^{3/2} + 30 \times 2.5^{3/2}]$

$= 1.45 [6.4 + 91.3 + 222.2 + 315.5 + 397.6 + 413.6 + 387.0 +$
$320.4 + 231.1 + 118.6] = 3630$ cfs

for $HW/D = 13/3.5 = 3.71$, $Q = 150$ cfs for 42"ø

$Q_{culv} = 2 \times 150 = 300$ cfs

$Q_T = Q_{EM} + Q_{culv} = 3630 + 300 = 3930$ cfs

* for $h = 10.0$, $Q_T = 3930$ cfs

for lake elev = 109.5, h = 11.0 — embankment overtopped by 6.9'

$Q_{EM} = \Sigma\, CLH^{3/2} = 1.45 [4 \times .1^{3/2} + 30 \times 1.2^{3/2} + 30 \times 3.1^{3/2} + 30 \times 4.8^{3/2} + 30 \times 5.8^{3/2} +$
$30 \times 6.6^{3/2} + 30 \times 6.75^{3/2} + 30 \times 6.5^{3/2} + 30 \times 5.85^{3/2} + 30 \times 4.9^{3/2} +$
$30 \times 3.5^{3/2} + 10 \times .5^{3/2}] = 1.45 [.1 + 39.4 + 163.7 +$
$315.5 + 419.0 + 508.7 + 526.1 + 497.2 + 424.5 + 325.4 +$
$196.4 + 3.5] = 4958$ cfs

for $HW/D = 14/3.5 = 4$ $Q = 160 \times 2 = 320$ cfs

$Q_T = Q_{EM} + Q_{culv} = 4960 + 320 = 5280$ cfs

* for $h = 11.0$, $Q_T = 5280$ cfs

for lake elev 110.5 $h = 12.0$ (embankment overtopped by 7.9')

$$Q_{Em} = \Sigma CLH^{3/2} = 1.45 [20 \times .6^{3/2} + 30 \times 2.2^{3/2} + 30 \times 4.1^{3/2} + 30 \times 5.8^{3/2} + 30 \times 6.8^{3/2} +$$
$$30 \times 7.6^{3/2} + 30 \times 7.75^{3/2} + 30 \times 7.5^{3/2} + 30 \times 6.85^{3/2} + 30 \times 5.9^{3/2} +$$
$$30 \times 4.5^{3/2} + 20 \times 1^{3/2}] = 1.45 [9.3 + 97.9 + 249.1 + 419.0$$
$$+ 532.0 + 628.6 + 647.3 + 616.2 + 537.8 + 429.9 +$$
$$286.4 + 20] = 6487.$$

for $HW/D = 15/3.5 = 4.3$ $\quad Q_c = 170 \times 2 = 340$ cfs

$$Q_T = Q_{Em} + Q_c = 6490 + 340 = 6830 \text{ cfs}$$

for lake elev = 111.5, $h = 13.0'$ (embankment overtopped by 8.9')

$$Q_{Em} = \Sigma CLH^{3/2} = 1.45 [4 \times .15^{3/2} + 30 \times 1.3^{3/2} + 30 \times 3.2^{3/2} + 30 \times 5.1^{3/2} + 30 \times 6.8^{3/2} +$$
$$30 \times 7.8^{3/2} + 30 \times 8.6^{3/2} + 30 \times 8.75^{3/2} + 30 \times 8.5^{3/2} + 30 \times 7.85^{3/2} +$$
$$30 \times 6.9^{3/2} + 30 \times 5.5^{3/2} + 30 \times 1.6^{3/2}] = 1.45 [.2 + 44.5 +$$
$$171.7 + 345.5 + 532.0 + 653.5 + 756.6 + 776.5 + 743.4 +$$
$$659.8 + 543.7 + 387.0 + 60.7] = 8229 \text{ cfs}$$

$Q_c \approx 360$ cfs

$$Q_T = Q_{Em} + Q_c = 8230 + 360 = 8590 \text{ cfs}$$

for lake elev = 112.5, $h = 14.0$ (embankment overtopped by 9.9' max.)

$$Q_{Em} = \Sigma CLH^{3/2} = 1.45 [20 \times .6^{3/2} + 30 \times 2.3^{3/2} + 30 \times 4.2^{3/2} + 30 \times 6.1^{3/2} + 30 \times 7.8^{3/2} +$$
$$30 \times 8.8^{3/2} + 30 \times 9.6^{3/2} + 30 \times 9.75^{3/2} + 30 \times 9.5^{3/2} + 30 \times 8.85^{3/2} +$$
$$30 \times 7.9^{3/2} + 30 \times 6.5^{3/2} + 30 \times 2.6^{3/2} + 10 \times .5^{3/2}]$$
$$= 1.45 [9.3 + 104.6 + 258.2 + 452.0 + 653.5 + 783.2 +$$
$$892.3 + 913.3 + 878.4 + 789.8 + 666.1 + 497.2 + 125.8 +$$
$$3.5] = 10{,}190 \text{ cfs}$$

$Q_c \cong 380$ cfs

$$Q_T = Q_{Em} + Q_c = 10{,}190 + 380 = 10{,}570 \text{ cfs}$$

<u>for lake elev = 113.5, h = 15.0'</u> (embankment overtopped by 10.9' max)

$Q_{EM} = \Sigma\, CLH^{3/2} = 1.45 [5' \times .1^{3/2} + 30 \times 1.3^{3/2} + 30 \times 3.3^{3/2} + 30 \times 5.2^{3/2} + 30 \times 7.1^{3/2} + 30 \times 8.8^{3/2} +$

$30 \times 9.8^{3/2} + 30 \times 10.6^{3/2} + 30 \times 10.75^{3/2} + 30 \times 10.5^{3/2} + 30 \times 9.85^{3/2} + 30 \times 8.9^{3/2} +$

$30 \times 7.5^{3/2} + 30 \times 3.6^{3/2} + 20 \times 1] = 1.45 [.2 + 44.5 + 179.8 + 355.7$

$+ 567.6 + 783.2 + 920.4 + 1035.3 + 1057.4 + 1020.7 + 927.4 + 796.5 +$

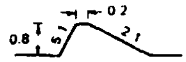
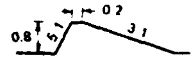
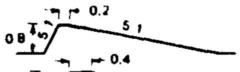
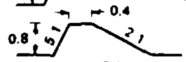
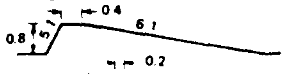
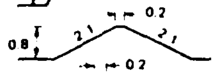
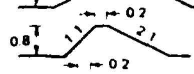
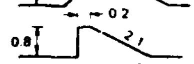
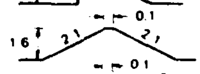
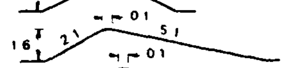
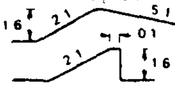
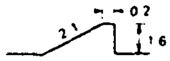
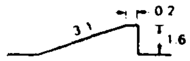
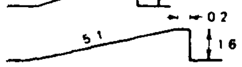
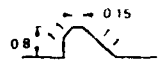
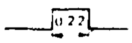
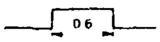
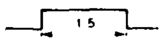
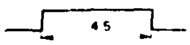
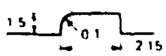
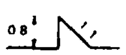
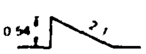
$616.2 + 204.9 + 20] = 12{,}368$ cfs

$Q_c \cong 400$ cfs

$Q_T = Q_{EM} + Q_c = 12{,}370 + 400 = \underline{\underline{12{,}770 \text{ cfs}}}$

ıp, or
Figure

Table 9-1 Discharge Coefficients for Broad Crested Weirs[a]

	Cross section	Upstream head *h* (m)							
		0.15	0.30	0.45	0.60	0.75	0.90	1.20	1.50
1		1.61	1.86	1.98					
2		1.60	1.80	1.90					
3		1.58	1.75	1.79					
4		1.53	1.64	1.77					
5		1.54	1.62	1.69					
6		1.72	1.88	1.98					
7		1.65	1.88	2.00					
8		1.53	1.80	1.93					
9					1.96	1.96	1.97	1.99	2.02
10					1.94	1.92	1.89	1.92	1.97
11			2.12	2.10	2.08	2.08	2.06	2.04	2.00
12			1.88	1.96	2.01	2.04	2.05	2.05	2.05
13					1.96	1.96	1.96	1.96	1.96
14					1.86	1.86	1.86	1.86	1.86
15		1.81	2.00						
16		2.10	2.35						
17		1.57	1.73	1.80	1.82	1.83	1.83		
18		1.44	1.46	1.55	1.56	1.69	1.76	1.84	
19		1.43	1.47	1.45	1.46	1.47	1.46	1.48	1.59
20		1.48	1.45	1.44	1.44				
21			1.56	1.60	1.65	1.70	1.74	1.84	1.92
22			1.56	1.56	1.55	1.55	1.55	1.55	1.54
23		2.13	2.13	2.13					
24		1.93	1.94	1.94					
25		1.94	1.98	1.97					

[a] All dimensions are in meters. Tabulated values represent metric weir coefficients.

quation

from Practical Hydraulics by Andrew L. Simon,
1976 by Wiley & Sons

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allowable headwater elevation. The major components of a culvert are its inlet, the culvert pipe barrel itself, and its outlet with the exit energy dissipator, if any. Each of these components have a definite discharge delivery capacity. The component having the least discharge delivery capacity will control the hydraulic performance of the whole structure.

One speaks of *inlet control* if, under given circumstances, the discharge of a culvert is dependent only on the headwater above the invert at the entrance, the size of the pipe, and the geometry of the entrance. With the inlet controlling the flow, the slope, length, and roughness of the culvert pipe does not influence the discharge. In this case, the pipe is always only partly full although the headwater may exceed the top of the pipe entrance and hence the flow enters the pipe under pressure. Figure 9.21 shows a typical nomograph by which the discharge Q could be determined for a culvert of D diameter under a headwater depth HW. The nomograph is for a square-edged entrance in a headwall. Similar nomographs are found in governmental and trade literature for many other entrance conditions. Short culverts with relatively negligible tailwater elevations almost always operate under inlet control. *Outlet control* occurs when the discharge is dependent on all hydraulic variables of the structure.

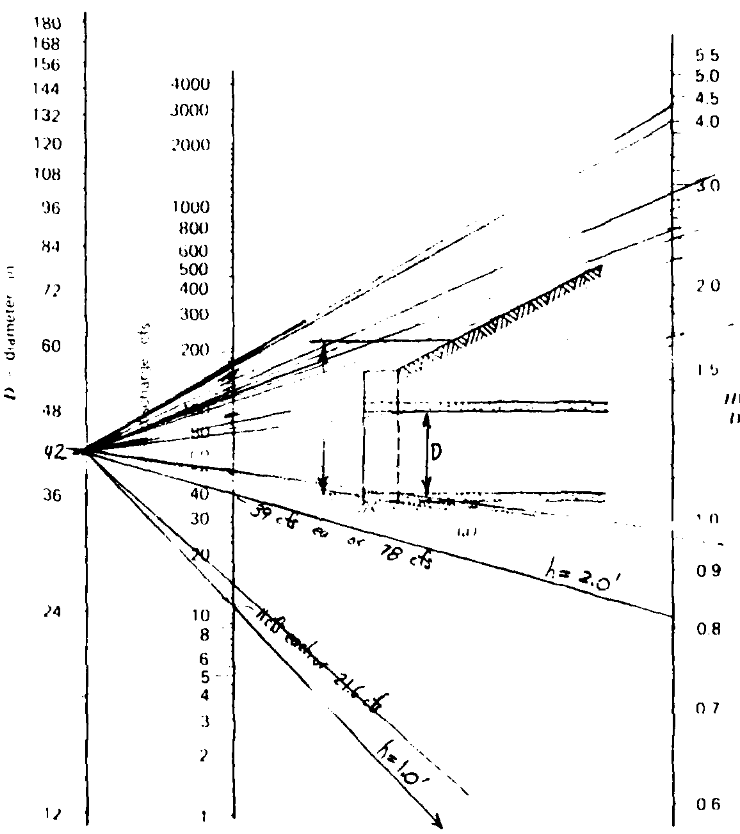

FIGURE 9.21 Typical nomograph for inlet controlled culvert design. (*a*) Square-edged entrance. (From *Handbook of Concrete Culvert Pipe Hydraulics*, Portland Cement Association, 1964.)

from 'Practical Hydraulics' by Andrew L. Simon 1976, Wiley & Sons

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```
1A1 ST JAMES LAKE DAM
 A2 HEC-1DB
 A3 PMF-DAM OVERTOPPING ANALYSIS
 B     90      1      0      0      0      0      0      0      4
 B1     5
 J      1      6      1
 J1    .2     .4     .5     .6     .8    1.0
 K      0      1      0      0      0      0      1
 K1 SUB AREA 1  RUNOFF - CLARK METHOD
 M      1      0   .778      0   5.14      0      0      0      1
 P      0   18.5    111    123    133    142
 T      0      0      0      0      0      0      1    0.1
 V      1      1
 X      2      2      1
 K      1      2      0      0      0      0      1
 K1 CHANNEL ROUTE THRU AREA 2
 Y      0      0      0      1      1
 Y1     1      0      0      0      0      0     -1
 Y6   .08    .04    .08    525    550   2400   .004
 Y7   100    550    150    540    180    540    200    525    220    525
 Y7   240    540    500    545    600    550
 K      0      2      0      0      0      0      1
 K1 SUB AREA 2 RUNOFF
 M      1      0   .865      0   5.14      0      0      0      1
 P      0   18.5    111    123    133    142
 T      0      0      0      0      0      0      1    0.1
 V   0.66   0.66
 X    1.3    1.3      1
 K      2      2
 K      1      4      0      0      0      0      1
 K1 CHANNEL ROUTE THRU AREA 3
 Y      0      0      0      1      1
 Y1     1      0      0      0      0      0     -1
 Y6   .08    .04    .08    510    540   4200   .006
 Y7   100    540    250    530    350    520    400    510    420    510
 Y7   600    520    750    530   1050    540
 K      0      3      0      0      0      0      1
 K1 SUB AREA 3 RUNOFF
 M      1      0  1.618      0   5.14      0      0      0      1
 P      0   18.5    111    123    133    142
 T      0      0      0      0      0      0      1    0.1
 V    .82    .82
 X    3.2    3.2      1
 K      0      5      0      0      0      0      1
 K1 SUB AREA 5 RUNOFF
 M      1      0   .732      0   5.14      0      0      0      1
 P      0   18.5    111    123    133    142
 T      0      0      0      0      0      0      1    0.1
 V    .94    .94
 X    1.5    1.5      1
 K      1      4      0      0      0      0      1
 K1 CHANNEL ROUTE THRU AREA 4
 Y      0      0      0      1      1
 Y1     1      0      0      0      0      0     -1
 Y6   .08    .04    .08    507    530   4500   .026
 Y7   100    530    200    520    260    515    300    507    320    507
 Y7   360    515    400    520    500    530
 K      0      4      0      0      0      0      1
 K1 SUB AREA 4 RUNOFF
 M      1      0  1.144      0   5.14      0      0      0      1
 P      0   18.5    111    123    133    142
 T      0      0      0      0      0      0      1    0.1
```

```
V     .94     .94
X       2       2       1
K       4       4
K       1       4       0       0       0       0       1
K1 ROUTE THRU ST JAMES LAKE DAM
Y       0       0       0       1       1
Y1      1       0       0       0       0       0      -1
Y4    511     512     513     514     515     516     517     518     519     520
Y4    521     522     523     524     525     526
Y5      0      28     100     151     185     278     569    1078    1820    2760
Y5   3930    5280    6830    8590   10570   12770
$S      0    32.2    50.5   233.5   416.5   599.5
$E    500     503     504     514     524     534
$$    511     8.5     3.2     1.5
$D    517    2.64     1.5     200
K       1       5       0       0       0       0       1
K1 CHANNEL ROUTE THRU AREA 6
Y       0       0       0       1       1
Y1      1       0       0       0       0       0      -1
Y6    .08     .04     .08     493     520    1300    .011
Y7    100     520     200     510     250     500     350     493     370     500
Y7    500     500     550     510     650     520
K       0       6       0       0       0       0       1
K1 SUB AREA 6 RUNOFF
M       1       0   0.344       0    5.14       0       0       0       1
P       0    18.5     111     122     133     142
T       0       0       0       0       0       0       1     0.1
V     .38     .38
X       1       1       1
K       2       5
K       1       6       0       0       0       0       1
K1 ROUTE  THRU CULVERT BELOW DAM
Y       0       0       0       1       1
Y1      1       0       0       0       0       0      -1
Y4    499     500     501     502     503     504     505     506     507     508
Y4    509     510     511     512     513     514     515     516     517     518
Y5     25      70     100     185     250     360     440     500     600     700
Y5    800     850     980    1470    2345    3680    5260    7410    9900   12770
K      99
A
1*******************************
 FLOOD HYDROGRAPH PACKAGE (HEC-1)
 DAM SAFETY VERSION     JULY 1978
   LAST MODIFICATION  26 FEB 79
 ********************************
1                               PREVIEW OF SEQUENCE OF STREAM NETWORK CALCULATIONS

                                        RUNOFF HYDROGRAPH AT          1
                                        ROUTE HYDROGRAPH TO           2
                                        RUNOFF HYDROGRAPH AT          2
                                        COMBINE  2 HYDROGRAPHS AT     2
                                        ROUTE HYDROGRAPH TO           4
                                        RUNOFF HYDROGRAPH AT          3
                                        RUNOFF HYDROGRAPH AT          5
                                        ROUTE HYDROGRAPH TO           4
                                        RUNOFF HYDROGRAPH AT          4
                                        COMBINE  4 HYDROGRAPHS AT     4
                                        ROUTE HYDROGRAPH TO           4
                                        ROUTE HYDROGRAPH TO           5
                                        RUNOFF HYDROGRAPH AT          6
                                        COMBINE  2 HYDROGRAPHS AT     5
                                        ROUTE HYDROGRAPH TO           6
                                        END OF NETWORK
```

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FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION     JULY 1978
  LAST MODIFICATION  26 FEB 79
********************************

RUN  DATE# 79/05/23.
     TIME# 09.35.59.


                       ST JAMES LAKE DAM
                       HEC-1DB
                       PMF-DAM OVERTOPPING ANALYSIS

                                                 JOB SPECIFICATION
                       NQ      NHR    NMIN    IDAY     IHR    IMIN   METRC     IPLT    IPRT   NSTAN
                       90        1       0       0       0       0       0        0       4       0
                                              JOPER     NWT   LROPT   TRACE
                                                  5       0       0       0


                                          MULTI-PLAN ANALYSES TO BE PERFORMED
                                               NPLAN= 1 NRTIO= 6 LRTIO= 1
                         RTIOS=     .20     .40     .50     .60     .80    1.00



              **********          **********          **********          **********          **********

                                              SUB-AREA RUNOFF COMPUTATION

                     SUB AREA 1  RUNOFF - CLARK METHOD

                                  ISTAQ    ICOMP    IECON    ITAPE     JPLT     JPRT    INAME   ISTAGE    IAUTO
                                      1        0        0        0        0        0        1        0        0

                                                    HYDROGRAPH DATA
                       IHYDG    IUHG    TAREA    SNAP    TRSDA    TRSPC    RATIO    ISNOW    ISAME    LOCAL
                           1       0      .78    0.00     5.14     0.00    0.000        0        1        0

                                                      PRECIP DATA
                               SPFE      PMS       R6      R12      R24      R48      R72      R96
                               0.00    18.50   111.00   123.00   133.00   142.00     0.00     0.00
TRSPC COMPUTED BY THE PROGRAM IS  .800

                                                        LOSS DATA
                LROPT   STRKR   DLTKR   RTIOL   ERAIN   STRKS   RTIOK   STRTL   CNSTL   ALSMX   RTIMP
                    0    0.00    0.00    1.00    0.00    0.00    1.00    1.00     .10    0.00    0.00

                                                  UNIT HYDROGRAPH DATA
                                         TC=  1.00     R=  1.00     NTA=  0

                                                     RECESSION DATA
                                   STRTQ=    2.00    QRCSN=    2.00    RTIOR= 1.00

                    UNIT HYDROGRAPH  6 END-OF-PERIOD ORDINATES, LAG=    .98 HOURS, CP=  .53  VOL= 1.00
               167.       223.       74.       25.        8.        3.

            0                                  END-OF-PERIOD FLOW
        MO.DA  HR.MN  PERIOD   RAIN   EXCS   LOSS    COMP Q      MO.DA  HR.MN  PERIOD   RAIN   EXCS   LOSS    COMP Q


                                                                                  SUM  21.02  17.37   3.65    8872.
                                                                                     ( 534.)( 441.)(  93.)( 251.23)
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********** ********** ********** ********** **********

HYDROGRAPH ROUTING

CHANNEL ROUTE THRU AREA 2

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
2	1	0	0	0	0	1	0	0

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
0.0	0.000	0.00	1	1	0	0	0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	-1.	0

NORMAL DEPTH CHANNEL ROUTING

QN(1)	QN(2)	QN(3)	ELNVT	ELMAX	RLNTH	SEL
.0800	.0400	.0800	525.0	550.0	2400.	.00400

CROSS SECTION COORDINATES--STA,ELEV,STA,ELEV--ETC

100.00 550.00 150.00 540.00 180.00 540.00 200.00 525.00 220.00 525.00
240.00 540.00 500.00 545.00 600.00 550.00

STORAGE	0.00	1.58	3.41	5.49	7.83	10.43	13.28	16.38	19.74	23.35
	27.22	31.34	37.95	50.46	68.40	91.78	119.62	149.90	182.58	217.63
OUTFLOW	0.00	75.04	242.80	489.51	813.99	1218.10	1704.87	2277.82	2940.75	3697.54
	4552.12	5508.42	6754.24	8411.09	10487.41	13073.73	16357.78	20248.74	24718.88	29778.51
STAGE	525.00	526.32	527.63	528.95	530.26	531.58	532.89	534.21	535.53	536.84
	538.16	539.47	540.79	542.11	543.42	544.74	546.05	547.37	548.68	550.00
FLOW	0.00	75.04	242.80	489.51	813.99	1218.10	1704.87	2277.82	2940.75	3697.54
	4552.12	5508.42	6754.24	8411.09	10487.41	13073.73	16357.78	20248.74	24718.88	29778.51

MAXIMUM STAGE IS 528.5

MAXIMUM STAGE IS 530.2

MAXIMUM STAGE IS 530.9

MAXIMUM STAGE IS 531.6

MAXIMUM STAGE IS 532.6

MAXIMUM STAGE IS 533.6

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**********          **********          **********          **********          **********

                              SUB-AREA RUNOFF COMPUTATION

         SUB AREA 2 RUNOFF

                        ISTAQ   ICOMP   IECON   ITAPE    JPLT    JPRT   INAME  ISTAGE   IAUTO
                            2       0       0       0       0       0       1       0       0

                                        HYDROGRAPH DATA
           IHYDG    IUHG    TAREA    SNAP   TRSDA   TRSPC   RATIO   ISNOW   ISAME   LOCAL
               1       0      .87    0.00    5.14    0.00   0.000       0       1       0

                                          PRECIP DATA
                     SPFE     PMS      R6     R12     R24     R48     R72     R96
                     0.00   18.50  111.00  123.00  133.00  142.00    0.00    0.00
TRSPC COMPUTED BY THE PROGRAM IS  .800

                                           LOSS DATA
        LROPT   STRKR   DLTKR   RTIOL   ERAIN   STRKS   RTIOK   STRTL   CNSTL   ALSMX   RTIMP
            0    0.00    0.00    1.00    0.00    0.00    1.00    1.00     .10    0.00    0.00

                                     UNIT HYDROGRAPH DATA
                              TC=    .66     R=    .66     NTA=  0

                                         RECESSION DATA
                        STRTQ=     1.30    QRCSN=     1.30    RTIOR= 1.00

         UNIT HYDROGRAPH  4 END-OF-PERIOD ORDINATES, LAG=     .86 HOURS, CP=  .52  VOL= 1.00
      240.      274.       38.        5.

        0                                END-OF-PERIOD FLOW
   MO.DA  HR.MN  PERIOD    RAIN    EXCS    LOSS    COMP Q      MO.DA  HR.MN  PERIOD    RAIN    EXCS    LOSS    COMP Q

                                                                                SUM  21.02  17.37   3.65     9768.
                                                                                   ( 534.)( 441.)(  93.)(  276.60)


**********          **********          **********          **********          **********

                                     COMBINE HYDROGRAPHS
                        ISTAQ   ICOMP   IECON   ITAPE    JPLT    JPRT   INAME  ISTAGE   IAUTO
                            2       2       0       0       0       0       0       0       0
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AD-A086 225 NEW YORK STATE DEPT OF ENVIRONMENTAL CONSERVATION ALBANY F/G 13/13
NATIONAL DAM SAFETY PROGRAM. ST. JAMES LAKE DAM (INVENTORY NUMB--ETC(U)
FEB 80 J B STETSON DACW51-79-C-0001

UNCLASSIFIED NL

2 of 2
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A086225

END
DATE
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8 80
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********** ********** ********** ********** **********

HYDROGRAPH ROUTING

CHANNEL ROUTE THRU AREA 3

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
4	1	0	0	0	0	1	0	0

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
0.0	0.000	0.00	1	1	0	0	0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	-1.	0

NORMAL DEPTH CHANNEL ROUTING

QN(1)	QN(2)	QN(3)	ELNVT	ELMAX	RLNTH	SEL
.0800	.0400	.0800	510.0	540.0	4200.	.00600

CROSS SECTION COORDINATES--STA,ELEV,STA,ELEV--ETC
100.00 540.00 250.00 530.00 350.00 520.00 400.00 510.00 420.00 510.00
600.00 520.00 750.00 530.00 1050.00 540.00

STORAGE	0.00	5.81	17.15	34.01	56.41	84.33	117.79	156.87	201.95	253.03
	310.12	373.22	442.32	517.71	602.84	698.80	805.56	923.15	1051.55	1190.77
OUTFLOW	0.00	181.42	790.36	1984.88	3908.38	6691.62	10456.18	16091.25	23306.45	31755.25
	41468.30	52476.77	64812.95	78375.03	93207.27	109708.25	127955.86	148034.05	170027.56	194020.07
STAGE	510.00	511.58	513.16	514.74	516.32	517.89	519.47	521.05	522.63	524.21
	525.79	527.37	528.95	530.53	532.11	533.68	535.26	536.84	538.42	540.00
FLOW	0.00	181.42	790.36	1984.88	3908.38	6691.62	10456.18	16091.25	23306.45	31755.25
	41468.30	52476.77	64812.95	78375.03	93207.27	109708.25	127955.86	148034.05	170027.56	194020.07

MAXIMUM STAGE IS 513.3

MAXIMUM STAGE IS 514.4

MAXIMUM STAGE IS 514.9

MAXIMUM STAGE IS 515.3

MAXIMUM STAGE IS 516.0

MAXIMUM STAGE IS P 516.6

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          **********          **********          **********          **********          **********

                                        SUB-AREA RUNOFF COMPUTATION

          SUB AREA 3 RUNOFF

                         ISTAQ   ICOMP   IECON   ITAPE    JPLT    JPRT   INAME  ISTAGE   IAUTO
                             3       0       0       0       0       0       1       0       0

                                            HYDROGRAPH DATA
          IHYDG    IUHG   TAREA    SNAP   TRSDA   TRSPC   RATIO   ISNOW   ISAME   LOCAL
              1       0    1.62    0.00    5.14    0.00   0.000       0       1       0

                                             PRECIP DATA
                   SPFE     PMS      R6     R12     R24     R48     R72     R96
                   0.00   18.50  111.00  123.00  133.00  142.00    0.00    0.00
TRSPC COMPUTED BY THE PROGRAM IS  .800

                                              LOSS DATA
       LROPT   STRKR   DLTKR   RTIOL   ERAIN   STRKS   RTIOK   STRTL   CNSTL   ALSMX   RTIMP
           0    0.00    0.00    1.00    0.00    0.00    1.00    1.00     .10    0.00    0.00

                                         UNIT HYDROGRAPH DATA
                                 TC=   .82     R=    .82    NTA=  0

                                            RECESSION DATA
                          STRTQ=    3.20   QRCSN=    3.20   RTIOR= 1.00

          UNIT HYDROGRAPH  5 END-OF-PERIOD ORDINATES, LAG=    .92 HOURS, CP=  .53  VOL= 1.00
       395.     491.     119.      29.       7.

            0                                 END-OF-PERIOD FLOW
     MO.DA  HR.MN  PERIOD   RAIN   EXCS   LOSS    COMP Q      MO.DA  HR.MN  PERIOD   RAIN   EXCS   LOSS    COMP Q

                                                                                 SUM  21.02  17.37   3.65    18360.
                                                                                    ( 534.)( 441.)(  93.)(  519.90)
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########## ########## ########## ########## ##########

SUB-AREA RUNOFF COMPUTATION

SUB AREA 5 RUNOFF

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
5	0	0	0	0	0	1	0	0

HYDROGRAPH DATA

IHYDG	IUHG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	0	.73	0.00	5.14	0.00	0.000	0	1	0

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96
0.00	18.50	111.00	123.00	133.00	142.00	0.00	0.00

TRSPC COMPUTED BY THE PROGRAM IS .800

LOSS DATA

LROPT	STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOK	STRTL	CNSTL	ALSMX	RTIMP
0	0.00	0.00	1.00	0.00	0.00	1.00	1.00	.10	0.00	0.00

UNIT HYDROGRAPH DATA

TC= .94 R= .94 NTA= 0

RECESSION DATA

STRTQ= 1.50 QRCSN= 1.50 RTIOR= 1.00

UNIT HYDROGRAPH 6 END-OF-PERIOD ORDINATES, LAG= .96 HOURS, CP= .53 VOL= 1.00

164. 214. 65. 20. 6. 2.

0 END-OF-PERIOD FLOW

MO.DA HR.MN PERIOD RAIN EXCS LOSS COMP Q MO.DA HR.MN PERIOD RAIN EXCS LOSS COMP Q

SUM 21.02 17.37 3.65 8352.
(534.)(441.)(93.)(236.50)

**********   **********   **********   **********   **********

HYDROGRAPH ROUTING

CHANNEL ROUTE THRU AREA 4

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
4	1	0	0	0	0	1	0	0

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
0.0	0.000	0.00	1	1	0	0	0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	-1.	0

NORMAL DEPTH CHANNEL ROUTING

QN(1)	QN(2)	QN(3)	ELNVT	ELMAX	RLNTH	SEL
.0800	.0400	.0800	507.0	530.0	4500.	.02600

CROSS SECTION COORDINATES--STA,ELEV,STA,ELEV--ETC
100.00 530.00 200.00 520.00 260.00 515.00 300.00 507.00 320.00 507.00
360.00 515.00 400.00 520.00 500.00 530.00

STORAGE	0.00	3.26	8.03	14.32	22.11	31.43	42.26	54.71	69.92	88.15
	109.41	133.69	161.01	191.35	224.72	261.12	300.54	343.00	388.48	436.98
OUTFLOW	0.00	186.26	675.21	1504.24	2725.15	4389.01	6544.93	9499.55	13477.32	18146.79
	23555.49	29745.89	36759.61	44634.26	53406.31	63111.75	73785.95	85463.70	98179.19	111966.07
STAGE	507.00	508.21	509.42	510.63	511.84	513.05	514.26	515.47	516.68	517.89
	519.11	520.32	521.53	522.74	523.95	525.16	526.37	527.58	528.79	530.00
FLOW	0.00	186.26	675.21	1504.24	2725.15	4389.01	6544.93	9499.55	13477.32	18146.79
	23555.49	29745.89	36759.61	44634.26	53406.31	63111.75	73785.95	85463.70	98179.19	111966.07

MAXIMUM STAGE IS 508.7

MAXIMUM STAGE IS 509.6

MAXIMUM STAGE IS 509.8

MAXIMUM STAGE IS 510.1

MAXIMUM STAGE IS 510.7

MAXIMUM STAGE IS 511.1

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SUB-AREA RUNOFF COMPUTATION

SUB AREA 4 RUNOFF

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
4	0	0	0	0	0	1	0	0

HYDROGRAPH DATA

IHYDG	IUHG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	0	1.14	0.00	5.14	0.00	0.000	0	1	0

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96
0.00	18.50	111.00	123.00	133.00	142.00	0.00	0.00

TRSPC COMPUTED BY THE PROGRAM IS .800

LOSS DATA

LROPT	STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOK	STRTL	CNSTL	ALSMX	RTIMP
0	0.00	0.00	1.00	0.00	0.00	1.00	1.00	.10	0.00	0.00

UNIT HYDROGRAPH DATA

TC= .94 R= .94 NTA= 0

RECESSION DATA

STRTQ= 2.00 QRCSN= 2.00 RTIOR= 1.00

UNIT HYDROGRAPH 6 END-OF-PERIOD ORDINATES, LAG= .96 HOURS, CP= .53 VOL= 1.00

256. 334. 102. 31. 10. 3.

0 END-OF-PERIOD FLOW

MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q	MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q
									SUM	21.02	17.37	3.65	12971.
										(534.)	(441.)	(93.)	(367.30)

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COMBINE HYDROGRAPHS

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
4	4	0	0	0	0	0	0	0

********** ********** ********** ********** **********

HYDROGRAPH ROUTING

ROUTE THRU ST JAMES LAKE DAM

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
4	1	0	0	0	0	1	0	0

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
0.0	0.000	0.00	1	1	0	0	0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	-1.	0

STAGE	511.00	512.00	513.00	514.00	515.00	516.00	517.00	518.00	519.00	520.00
	521.00	522.00	523.00	524.00	525.00	526.00				
FLOW	0.00	28.00	100.00	151.00	185.00	278.00	569.00	1078.00	1820.00	2760.00
	3930.00	5280.00	6830.00	8590.00	10570.00	12770.00				

CAPACITY=	0.	32.	51.	234.	417.	600.
ELEVATION=	500.	503.	504.	514.	524.	534.

CREL	SPWID	COQW	EXPW	ELEVL	COQL	CAREA	EXPL
511.0	8.5	3.2	1.5	0.0	0.0	0.0	0.0

DAM DATA

TOPEL	COQD	EXPD	DAMWID
517.0	2.6	1.5	200.

PEAK OUTFLOW IS 3081. AT TIME 41.00 HOURS

PEAK OUTFLOW IS 5453. AT TIME 41.00 HOURS

PEAK OUTFLOW IS 7046. AT TIME 41.00 HOURS

PEAK OUTFLOW IS 8383. AT TIME 41.00 HOURS

PEAK OUTFLOW IS 10962. AT TIME 41.00 HOURS

PEAK OUTFLOW IS 13760. AT TIME 41.00 HOURS

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**********          **********          **********          **********          **********

                                   HYDROGRAPH ROUTING

               CHANNEL ROUTE THRU AREA 6

                        ISTAQ   ICOMP   IECON   ITAPE    JPLT    JPRT   INAME  ISTAGE   IAUTO
                            5       1       0       0       0       0       1       0       0
                                              ROUTING DATA
                   QLOSS    CLOSS     AVG    IRES   ISAME    IOPT    IPMP            LSTR
                     0.0    0.000    0.00       1       1       0       0               0

                        NSTPS   NSTDL     LAG   AMSKK       X     TSK   STORA  ISPRAT
                            1       0       0   0.000   0.000   0.000     -1.       0
```

NORMAL DEPTH CHANNEL ROUTING

```
QN(1)   QN(2)   QN(3)   ELNVT   ELMAX   RLNTH     SEL
.0800   .0400   .0800   493.0   520.0   1300.  .01100
```

```
CROSS SECTION COORDINATES--STA,ELEV,STA,ELEV--ETC
  100.00  520.00  200.00  510.00  250.00  500.00  350.00  493.00  370.00  500.00
  500.00  500.00  550.00  510.00  650.00  520.00
```

STORAGE	0.00	.52	2.07	4.65	8.27	13.32	24.27	35.82	47.97	60.73
	74.09	88.05	102.62	118.11	134.80	152.70	171.81	192.12	213.64	236.36
OUTFLOW	0.00	53.42	339.20	1000.08	2153.79	2556.30	6802.20	12610.93	19846.02	28427.18
	38302.21	49435.38	61791.99	75180.19	89898.13	105954.09	123365.34	142153.08	162340.48	183951.76
STAGE	493.00	494.42	495.84	497.26	498.68	500.11	501.53	502.95	504.37	505.79
	507.21	508.63	510.05	511.47	512.89	514.32	515.74	517.16	518.58	520.00
FLOW	0.00	53.42	339.20	1000.08	2153.79	2556.30	6802.20	12610.93	19846.02	28427.18
	38302.21	49435.38	61791.99	75180.19	89898.13	105954.09	123365.34	142153.08	162340.48	183951.76

MAXIMUM STAGE IS 500.2

MAXIMUM STAGE IS 501.1

MAXIMUM STAGE IS 501.5

MAXIMUM STAGE IS 501.9

MAXIMUM STAGE IS 502.6

MAXIMUM STAGE IS 503.2

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**********          **********          **********          **********          **********

                              SUB-AREA RUNOFF COMPUTATION

     SUB AREA 6 RUNOFF

                    ISTAQ   ICOMP   IECON   ITAPE    JPLT    JPRT   INAME  ISTAGE   IAUTO
                        6       0       0       0       0       0       1       0       0

                                    HYDROGRAPH DATA
           IHYDG    IUHG   TAREA    SNAP   TRSDA   TRSPC   RATIO   ISNOW   ISAME   LOCAL
               1       0     .34    0.00    5.14    0.00   0.000       0       1       0

                                     PRECIP DATA
                SPFE     PMS      R6     R12     R24     R48     R72     R96
                0.00   18.50  111.00  122.00  133.00  142.00    0.00    0.00
TRSPC COMPUTED BY THE PROGRAM IS  .800

                                      LOSS DATA
        LROPT   STRKR   DLTKR   RTIOL   ERAIN   STRKS   RTIOK   STRTL   CNSTL   ALSMX   RTIMP
            0    0.00    0.00    1.00    0.00    0.00    1.00    1.00     .10    0.00    0.00

                                 UNIT HYDROGRAPH DATA
                             TC=    .38    R=    .38    NTA=  0

                                    RECESSION DATA
                        STRTQ=     1.00    QRCSN=     1.00    RTIOR= 1.00

     UNIT HYDROGRAPH  2 END-OF-PERIOD ORDINATES, LAG=     .79 HOURS, CP=  .50  VOL= 1.00
   111.     111.

   0                                 END-OF-PERIOD FLOW
MO.DA  HR.MN  PERIOD   RAIN   EXCS   LOSS   COMP Q      MO.DA  HR.MN  PERIOD   RAIN   EXCS   LOSS   COMP Q

                                                                          SUM  21.02  17.36   3.66    3942.
                                                                              ( 534.)( 441.)(  93.)(  111.63)


**********          **********          **********          **********          **********

                                  COMBINE HYDROGRAPHS
                    ISTAQ   ICOMP   IECON   ITAPE    JPLT    JPRT   INAME  ISTAGE   IAUTO
                        5       2       0       0       0       0       0       0       0
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HYDROGRAPH ROUTING

ROUTE THRU CULVERT BELOW DAM

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
6	1	0	0	0	0	1	0	0

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP		LSTR
0.0	0.000	0.00	1	1	0	0		0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	-1.	0

STAGE	499.00	500.00	501.00	502.00	503.00	504.00	505.00	506.00	507.00	508.00
	509.00	510.00	511.00	512.00	513.00	514.00	515.00	516.00	517.00	518.00
FLOW	25.00	70.00	100.00	185.00	250.00	360.00	440.00	500.00	600.00	700.00
	800.00	850.00	980.00	1470.00	2345.00	3680.00	5260.00	7410.00	9900.00	12770.00

MAXIMUM STAGE IS 510.0

MAXIMUM STAGE IS 512.6

MAXIMUM STAGE IS 513.1

MAXIMUM STAGE IS 513.6

MAXIMUM STAGE IS 514.4

MAXIMUM STAGE IS 515.1

********** ********** ********** ********** **********

1

PEAK FLOW AND STORAGE (END OF PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
AREA IN SQUARE MILES (SQUARE KILOMETERS)

				RATIOS APPLIED TO FLOWS					
OPERATION	STATION	AREA	PLAN	RATIO 1 .20	RATIO 2 .40	RATIO 3 .50	RATIO 4 .60	RATIO 5 .80	RATIO 6 1.00
HYDROGRAPH AT	1	.78	1	395.	790.	988.	1185.	1580.	1975.
	(	2.02)	(	11.19)(	22.37)(	27.97)(	33.56)(	44.75)(	55.94)(
ROUTED TO	2	.78	1	405.	808.	1010.	1210.	1614.	2016.
	(	2.02)	(	11.47)(	22.87)(	28.60)(	34.27)(	45.70)(	57.08)(
HYDROGRAPH AT	2	.87	1	462.	924.	1155.	1386.	1848.	2310.
	(	2.24)	(	13.08)(	26.17)(	32.71)(	39.25)(	52.34)(	65.42)(
2 COMBINED	2	1.64	1	867.	1732.	2165.	2596.	3462.	4326.
	(	4.26)	(	24.55)(	49.04)(	61.31)(	73.52)(	98.03)(	122.50)(
ROUTED TO	4	1.64	1	880.	1760.	2216.	2676.	3550.	4440.
	(	4.26)	(	24.92)(	49.84)(	62.75)(	75.77)(	100.52)(	125.73)(
HYDROGRAPH AT	3	1.62	1	847.	1694.	2118.	2542.	3389.	4236.
	(	4.19)	(	23.99)(	47.98)(	59.98)(	71.97)(	95.96)(	119.95)(
HYDROGRAPH AT	5	.73	1	376.	751.	939.	1127.	1503.	1879.
	(	1.90)	(	10.64)(	21.28)(	26.60)(	31.92)(	42.56)(	53.20)(
ROUTED TO	4	.73	1	384.	775.	967.	1155.	1533.	1928.
	(	1.90)	(	10.88)(	21.94)(	27.39)(	32.71)(	43.41)(	54.60)(
HYDROGRAPH AT	4	1.14	1	587.	1174.	1468.	1761.	2349.	2936.
	(	2.96)	(	16.63)(	33.25)(	41.56)(	49.88)(	66.50)(	83.13)(
4 COMBINED	4	5.14	1	2699.	5403.	6769.	8134.	10820.	13540.
	(	13.30)	(	76.42)(	153.01)(	191.68)(	230.33)(	306.39)(	383.41)(
ROUTED TO	4	5.14	1	3081.	5453.	7046.	8383.	10962.	13760.
	(	13.30)	(	87.24)(	154.41)(	199.53)(	237.38)(	310.40)(	389.63)(
ROUTED TO	5	5.14	1	2945.	5433.	6818.	8270.	11175.	13890.
	(	13.30)	(	83.38)(	153.86)(	193.05)(	234.18)(	316.45)(	393.31)(
HYDROGRAPH AT	6	.34	1	189.	378.	472.	567.	756.	945.
	(	.89)	(	5.35)(	10.70)(	13.38)(	16.05)(	21.40)(	26.75)(
2 COMBINED	5	5.48	1	3130.	5804.	7281.	8826.	11917.	14816.
	(	14.20)	(	88.63)(	164.35)(	206.17)(	249.92)(	337.44)(	419.54)(
ROUTED TO	6	5.48	1	848.	2024.	2528.	3106.	4272.	5421.
	(	14.20)	(	24.02)(	57.30)(	71.59)(	87.96)(	120.96)(	153.52)(

PLAN 1 STATION 2

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.20	405.	528.5	41.00
.40	808.	530.2	41.00
.50	1010.	530.9	41.00
.60	1210.	531.6	41.00
.80	1614.	532.6	41.00
1.00	2016.	533.6	41.00

PLAN 1 STATION 4

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.20	880.	513.3	41.00
.40	1760.	514.4	41.00
.50	2216.	514.9	41.00
.60	2676.	515.3	41.00
.80	3550.	516.0	41.00
1.00	4440.	516.6	41.00

PLAN 1 STATION 4

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.20	384.	508.7	41.00
.40	775.	509.6	41.00
.50	967.	509.8	41.00
.60	1155.	510.1	41.00
.80	1533.	510.7	41.00
1.00	1928.	511.1	41.00

1 SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 ....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	500.00	511.00	517.00
STORAGE	0.	179.	288.
OUTFLOW	0.	0.	400.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.20	519.73	2.73	338.	3081.	5.00	41.00	0.00
.40	521.21	4.21	365.	5453.	6.00	41.00	0.00
.50	522.08	5.08	381.	7046.	8.00	41.00	0.00
.60	522.75	5.75	394.	8383.	8.00	41.00	0.00
.80	523.96	6.96	416.	10962.	9.00	41.00	0.00
1.00	525.16	8.16	438.	13760.	9.00	41.00	0.00

PLAN 1 STATION 5

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS

APPENDIX D

REFERENCES

APPENDIX

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